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FOREST ORGANIZATION FOR BEGINNERS.

(*Continued from page 244*).

CHAPTER V.

COLLECTING FURTHER STATISTICS: FORMULATING RESULTS.

While the forest is being explored in the manner described in the last Chapter, notes should be made regarding the future treatment of each group or compartment. Not that it is necessary to carry out the views expressed in the notes as to the future management of any particular group, as modifications may have to be made when the group comes to be treated as part of a series,* but in order to get a basis on which to form a general plan of operations. Particulars to notice are, for instance, the advisability of a change of species, owing to bad growth of the standing stock, or to other reasons: the best mode of regenerating groups or re-stocking blanks and wastes: improvements which appear necessary in regard to roads, rides, young growth (stopping, thinning, &c.), drainage, and so forth.

Statistics of prices of all descriptions of principal and minor produce should also be collected, and inquiry made into the requirements of the population in the vicinity of the forest and its rights, or privileges, to take produce free, or on payment of royalties, together with a brief history of the forest, including a statement of the tenure of the owner, of the rights of others, and of its past treatment. A note should also be made of any lands of others, either inside, or outside, the forest, which it would be desirable to acquire for forest purposes by exchange or purchase.

In a forest which is being organized for the first time, it will not often be possible to give returns of the past yields of groups separately, but records of the yield of the whole forest in timber,

* When a number of groups are worked in connection with each other, so as to make up the annual yield during the whole revolution, they are said to constitute a series.

firewood, (thinnings separately,) and minor produce for several years back will often be available, together with the receipts and expenditure. It will then be possible to fix with more or less certainty the average gross and nett value of the standard unit of measure for each species and for each description of produce: the most useful kinds to grow: the best revolution to adopt: and the quantity of material which can be disposed of yearly.

Other points to observe are:—The principal markets, roads, or other means of transport (railways, rivers). Large industrial undertakings demanding a constant supply of produce, such as paper and sawmills, mining and smelting-works; price of labour, and whether it is abundant or difficult to procure when required; nature, frequency or comparative absence, of forest crime; the temporary and permanent staff required to guard the forest and to carry out forest operations. Any other useful information likely to affect the working of the forest should be noted, and in any case in which improvements seem possible suggestions should be made accordingly.

The more important data should be scheduled in the following statements:—

1. Statement of Area.
2. Statement of Groups.
3. Statement of Age-Classes.
4. Statement of Boundary-Marks.

1.—Statement of Area.

This may be drawn up in the following form:—

Detailed Statement of Area of Kodali Range, consisting of 12003·05 *acres, of which* 11200·55 *are forest-land, and* 802·5 *roads, rides, ponds, or unculturable waste*: 1886.

Locality.	Compartments and sub-compartments	Cultivable forest-land. Acres.	Unculturable land.	Total.	Remarks.
Belmal, ...	1*a*	16·05	...	...	
	b	21·30	...	...	
	c	17·02	...	...	
	d	31·57	...	...	
	e	...	1·02	79·96	Pond.
	2*a*	15·12	...	...	
	b	28·91	...	...	
	c	45·30	...	89·33	
	3*a*	40·32	...	...	
		&c.		&c.	

Particulars of groups in the first series of the Nandi beat of the Kodali Range, Pundra Division, in 1886.

COMPARTMENT NO. 1.

Locality.	Sub-compartments.	Area, acres.	Species.	Age. Years.	Age. Class.	Quality. tation.	Quality. Group.	Leaf cover.	Density.	Description of Station.	Cubic contents, feet. Per acre fully stocked.	Cubic contents, feet. Per sub-compartment.	Increment, cubic feet. Per acre.	Increment, cubic feet. Whole area.	Remarks and suggestions for future management.
Belmal, ..	*a*,	5·51	·6 Tk., ·4 Ter.,	45–55	III.	·2	III. Tk., I. Ter.	·6	·6	Formation gneiss, soil shallow, very light loam, with slight layer of humus under Xylia; other parts covered with a growth of short grass: gentle slope inclining to the N. E.	..	10,414			*Abbreviations.*—*Tk.*, teak: *Ter.*, *Terminalia tomentosa*: *Xy.*, *Xylia dolabriformis.*
	b,	20·11	Xylia, ..	50	III.	·8	IV.	·9	·9		4,050	73,301			(*a*). Naturally-grown group, situation unsuited to teak, getting very open; broadcast sowing of bamboo for ground-cover desirable.
	c,	10·57	Waste, ..	..	..	·8	..	..	..		..	..			(*b*). Good, vigorous growth, humus-covering to soil: requires thinning lightly in parts.
	d,	5·50	·5 Tk., ·5 Xy.,	90-100	V.	·6	I. Tk., III. Xy.	·4	·4		2,420	5,324			(*c*). Abandoned field, 10 years fallow: plant up, in combination with a crop of grain, with bamboo, and Xylia with ·5 of teak. Water close to in nullah. Rank growth of grass.
	e,	7·57	·5 Tk., ·5 Ter.,	15	I.	·8	IV. Tk., III. Ter.	1·0	1·0		..	..			(*d*). Growth very bad, should be cut away, and planted up in the same manner as (*c*), water close to in nullah. Long grass.
Total, ..	..	44·26													(*e*). Alternate rows of teak and Terminalia planted at 5 feet distances. Growth good.

2.—Statement of Groups.

The preceding form, (p. 289,) which is similar to that given at page 2,* may be used in this case for series subject to the method of regular cuttings (*see* p. 3*), at least one page being given to each compartment. The unstocked area (taken up by rides, &c.) may be stated at the beginning or end. It will seldom be necessary to give the contents of young groups, or those which are not likely to be exploited during the first period or two. This matter will depend in a great measure on the system of management adopted, as we shall see further on when examining the methods for determining the annual yield.

This form naturally requires modification in the case of forest treated by the primitive method, or the overwood of stored coppice. In the former case, the columns for the quality-classes and age-classes of groups will disappear, and, instead of the cubic contents of the whole group, those of superior diameter-classes will generally have to suffice. The increment-column should show the increment per cent. for each superior diameter-class, and a column may be added showing the estimated number of stems in each such class. Similar alterations are evidently advisable in the case of overwood in stored coppice.

3.—Statement of Age-Classes.

The object of this statement is to show at a glance the area occupied by each age-class of mixed and unmixed groups. There should be a separate statement for each series of a range. The quality-classes of groups should also be stated.

The following form is suitable for series subject to the method of regular cuttings; for other systems, diameter-classes may have to be substituted for age-classes, and the number of trees, or cubic feet, for the acreage.

Statement showing the Age-Classes of the First Series of Kodali Range in 1886.

Sub-compartment.	Quality-class of the group.	Class I. 1—20 years. Acres.	Class II. 21—40 years. Acres.	Class III. 41—60 years. Acres.	Class IV. 61—80 years. Acres.	Class V. 81—100 years. Acres.	Class VI. 101—120 years. Acres.	Class VII. 121—140 years. Acres.	Blanks.	Wastes.
1 *a*	IV.	...	...	...	...	...	5·75			
b	IV.	...	...	...	10·41					
c	III.	...	...	...	...	25·10				
d	IV.	...	...	...	15·73					
7 *c*	I.	10·45	...							
d	I.	5·13	...							
13 *a*	III.	...	13·5							
Total, ..		15·58	13·5	...	26·14	25·10	5·75			

* January No. of "Forester," 1886.

4.—Statement of Boundary-Marks.

Besides being shown on the map, it is well to have a register of boundary-marks, so that, in the event of any disappearing, the exact position in which they should be may be easily found. The following form includes all the data which it is desirable to have recorded, but, of course, it will often be impossible to keep so complete a statement.

Statement of Boundary-Marks in Kodali Range in 1886.

Adjacent compartment.	Number of mark.	Description of mark.	Distance to boundary mark on the right, facing inwards. Yards.	Angle included by lines joining centre station with boundary marks on right and left facing inwards.	Remarks.
1	1	Stone	150·45	75° 31′	Meets the stream.
1	2	do.	200·30	105° 10′	On edge of meadow.
			&c.		

It will often be possible to schedule other important matters, such as the past annual yields and average prices of different kinds of produce, which are more easily examined in a concise form.

SECTION IV.—DETERMINATION OF YIELD.

Chapter VI.—Determination of the Yield of Forests Regenerated by the Method of Regular Cuttings.*

In large forests, the *ultimate* object to be attained is the annual cutting of a tolerably uniform quantity of material of the most useful descriptions, combined with a good sequence of cuttings in each *block*, a term which is used to denote the parts of a forest lying between any two main-rides, or their substitutes. A good sequence of cuttings is that in which the age-classes in a block follow each other in order of age, the youngest groups being, at the beginning of the revolution, at the end from which storms are mostly to be feared, and the oldest at the opposite

* The term *regular cutting* is here used in the sense in which it is defined in page 3 (January No.). It is essential to note this.

end. By this arrangement, when the oldest groups, or portions of them, are cut away, the trees left standing—which, if they have grown up in thickish cover, are sure to be weakly-rooted—are not suddenly exposed to the full force of the most dangerous winds; they are protected by the groups in the block lying in front of them. The young growth and the isolated mother-trees in groups naturally regenerated are also sheltered for some time by the forest in front of them. In very irregular forests, a good sequence of age-classes cannot always be attained in one revolution, nor the cutting of an even tolerably-uniform quantity of material, but it is generally possible at least to prepare the way, without much loss, for the gradual attainment of these ends.

The principal methods of determining the annual yield are:—

1. The method of equal annual areas.
2. The method of periodic areas.
3. Hartig's method.
4. The combined method.

1. Method of equal annual areas.

This affords the simplest means of fixing the annual coupe, the area of which is found by dividing the area of the series by the number of years in the revolution. If the area of a series is 1,000 acres and the revolution 50 years, the area of the yearly coupe would be 1000 ÷ 50 = 20 acres, and if each coupe be re-stocked immediately after a cutting, there will evidently be a sustained yield after the first revolution, provided that the station is of uniform quality and that nothing arises to disturb the regular sequence of coupes.

If, however, the station is not of uniform quality, the yield may vary considerably, especially in forests subject to long revolutions, and for this reason the method of proportional coupes is sometimes adopted: that is, the area of the coupe is made inversely proportional to its relative yield.

Supposing, for example, that we have a series stocked with coppice, and consisting of the following compartments, and that the revolution is 30 years.

Compartment 1, of 50 acres, capable, it is estimated, of yielding in the 30th year 2,550 cubic feet per acre.

Compartment 2, of 65 acres, capable of yielding 2,040 cubic feet in the 30th year.

Compartment 3, of 45 acres, capable of yielding 1,730 cubic feet in the 30th year.

We would then have a total production during a revolution of

From No. 1,	...	50 × 2,550 =	127,500 feet.
From No. 2,	...	65 × 2,040 =	132,600 „
From No. 3,	...	45 × 1,730 =	77,850 „
	Total	...	337,950 „

The mean yearly production would, therefore, be for a complete series

$$\frac{337950}{30} = 11{,}265 \text{ cubic feet,}$$

and the size of a coupe would be in

Compartment 1, ... $\frac{11265}{2550} = 4{\cdot}41$ acres.

„ 2, ... $\frac{11265}{2040} = 5{\cdot}52$ „

„ 3, ... $\frac{11265}{1730} = 6{\cdot}51$ „

Another method is to make the area of the coupe inversely proportional to the estimated relative quality of the station.

In the above example, for instance, if the quality of the best station, say No. 2, is taken as a standard of comparison, and represented by unity, of No. 1 by ·9, and of No. 3 by ·7, we should have

65 acres giving each the full yield of	65	standard	acres.
50 „ giving ·9 of the full yield, or the equivalent of only ...	45	„	„
45 acres giving ·7 of the full yield, or the equivalent of only ...	31·5	„	„
Total equivalent to ...	141·5	„	„

For a revolution of 30 years the coupe must, therefore, be equal to a standard coupe of

$$\frac{141{\cdot}5}{30} = 4{\cdot}72 \text{ acres,}$$

and in No. 1 compartment the size of the coupe would be

$$\frac{4{\cdot}72}{{\cdot}9} = 5{\cdot}24 \text{ acres;}$$

in No. 2 compartment $\frac{4{\cdot}72}{1{\cdot}0} = 4{\cdot}72$ „

and in No. 3 compartment $\frac{4{\cdot}72}{{\cdot}7} = 6{\cdot}74$ „

Supposing the data of the estimate to be correct, the former method would give a uniform yield during the revolution, but would not bring about the ideal state at the end. This object would be attained by the latter method at the cost of more or less irregular yields during the revolution. The plan, however, which is usually adopted, and which answers all practical purposes in *coppice-forest*, is to consider the yearly coupe equal to $\frac{A}{r}$; the cuttings in that case can be equalised, if necessary, by taking a little more here or a little less there, when it is found that the yield is above or below the average.

The annual coupes are sometimes marked off on the map, and are demarcated on the ground by means of stones, or other

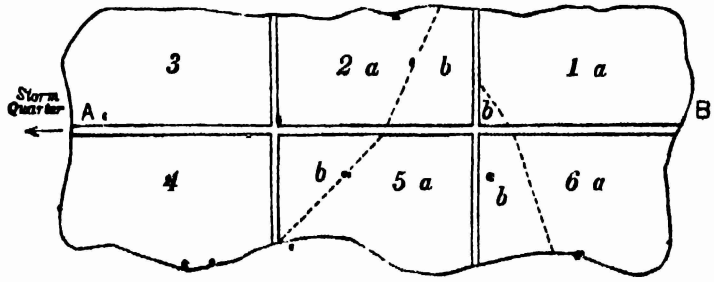
boundary-marks ; but, for the following reasons, it is better not to do so. (1), if the demarcation is carried out in the forest, and any alterations are subsequently made in the area of the series, the original demarcation will no longer hold good ; (2), if the productive power of the station varies considerably on a coupe, it may be desirable to compensate for such variations from time to time by exploiting a somewhat larger, or smaller, area than the normal, according to circumstances ; but this could not be done if each annual coupe were marked off beforehand ; (3), the expense ; (4), it prevents any change in the length of the revolution.

This method of determining the annual yield can only be employed in the case of coppice-forests, which, owing to their short revolutions and mode of regeneration, are much less liable to considerable fluctuations of yield, delays in re-stocking, and dangers from natural causes.

Its unsuitability to seedling-forest will be quite clear from the following considerations. The yield from a good station may easily amount to double that of a bad station in a forest subject to a revolution of only 100 years, and, as it would not generally answer in extensive forests to cut twice as much one year as was cut during another, it would be necessary in such cases to have coupes inversely proportional to their estimated power of production ; but such estimates for long periods are of little value. Again, in forests naturally regenerated by seed, trees are only gradually removed and several coupes would have to be taken in hand at the same time, which would virtually amount to adopting a totally different system. Damage by insects is another possible cause of alterations in the original plan : groups may thereby be killed outright, or so injured that it is necessary to regenerate them at once. The same result may be brought about by snow, fire, and wind which often cause great havoc in groups that have reached, or passed, the sapling-stage.

Example of the Determination of the Annual Yield by the Method of equal annual areas.

The accompanying map represents the plan of a completely-



stocked seedling-forest of teak of 360 acres, which is to be converted into coppice with a revolution of 30 years.

The area consists of two independent blocks, separated by the main ride (AB), and is divided into six compartments, of 60 acres each, containing the following groups :—

1*a*,	56	acres,	group	25 years old.
1*b*,	4	„	„	5 „
2*a*,	40	„	„	15 „
2*b*,	20	„	„	5 „
3,	60	„	„	35 „
4,	60	„	„	35 „
5*a*,	40	„	„	27 „
b,	20	„	„	15 „
6*a*,	36	„	„	5 „
b,	24	„	„	31 „

It is found by experimental cuttings that the yield is as follows :—

Average Yield per Acre.

Age of group.	Cubic contents, feet.	Average yearly growth, feet.
15	725	48
20	1,300	65
25	1,750	70
30	2,100	70
35	2,380	68
40	2,600	65
45	2,880	64

The annual coupe will amount to $\frac{360}{30} = 12$ acres. For the sake of shortness, we will divide the whole into three periods of 10 years each, comprising $12 \times 10 = 120$ acres each. The reader can easily imagine each of these 120 acre-plots split up into the annual coupes of 12 acres each.

The stormy quarter being on the left, the cuttings should progress from right to left.*

The compartments most suitable for the first period, having regard to the age of the groups they contain, are numbers 3 and 4, of 60 acres each, with groups 35 years old. As the adjacent groups in 2*a* and 5*b* are only 15 years old, there appears to be no objection to exposing these by cutting away the older groups

* This rule is rigorously applicable only to seedling-forest; in coppice-forest, little is to be feared from storms, and an arrangement of cuttings, which affords protection to the young growth from sun or dry winds will often be of more importance.

in front of them. We should then have the following yield and coupes for the first period:—

Compartment.	Present age of group.	Average age of group at time of cutting.	Area of compartment or sub-compartment.	Yield per acre, cubic feet.	Total yield of group.	Yield of 1st period 1886-95.	Mean yearly yield.
4	35	40	60	2,600	156,000	312,000	31,200
3	35	40	60	2,600	156,000		

At the end of the first period the oldest groups remaining will be

6*b*, of 24 acres, with group 41 years old.
5*a*, „ 40 „ „ 37 „
1*a*, „ 56 „ „ 35 „

The groups in 6*a*, behind 6*b*, being only 15 years old, there is no objection to the older group being cut. 1*a* may evidently be cut, and after the removal of 6*b*, 5*a* may also be cut. For the second period, we would then have the following yield and coupes:—

Compartment.	Age of group at beginning of the period.	Average age of group at time of cutting.	Area of coupes.	Yield per acre.	Total yield.	Yield of second period.	Average annual yield per annum.
			Acres.	Feet.		Cubic ft.	Feet.
6*b*	41	46	24	2,944	70,856	...	...
5*d*	37	42	40	2,730	1,09,200	3,25,456	32,546
1*a*	35	40	56	2,600	1,45,600	...	...

For the third period we would have remaining

2*b*, of 20 acres, with group 25 years old.
2*a*, „ 40 „ „ 35 „
5*b*, „ 20 „ „ 35 „
6*a*, „ 36 „ „ 25 „
1*b*, „ 4 „ „ 25 „

These might be worked in the order named, without any danger to standing-stock. The yield would then be

Compartment.	Age of group at beginning of period.	Average age of group at time of cutting.	Area of coupes.	Yield per acre.	Total yield.	Yield of third period.	Average yield per annum.
			Acres.	Feet.		Cubic ft.	Feet.
2*b*	25	30	20	2,100	42,000	...	...
2*a*	35	40	40	2,600	1,04,000	...	...
5*b*	35	40	20	2,600	52,000	2,82,000	28,200
6*a*	25	30	36	2,100	75,600	...	...
1*b*	25	30	4	2,100	8,400	...	...

At the end of the revolution the oldest group would be 30 years of age, and the average age of the groups to be cut during the following period would be 25 years. During the next revolution, therefore, the sub-compartments might be got rid of, if desired, without much loss; 40 acres stocked with groups averaging 20 years of age instead of 30 would have to be entered in the first period; on the other hand, two-thirds of the groups in five, occupying 40 acres, would have to be cut at an average age of 40 years. Supposing the relative production to be the same as before, the yield for the second revolution would then be:—

Period.	Compartment.	Age at beginning of period.	Average age of groups at time of cutting.	Area of compartment or sub-compartment.	Yield per acre, feet.	Total yield of group.	Yield of period.	Mean yearly yield.
I.	3	25	30	60	2,100	1,26,000	2,52,000	25,200
	4	25	30	60	2,100	1,26,000		
II.	1*a*	25	30	56	2,100	1,17,600	2,20,000	22,000
	b	15	20	4	1,300	5,200		
	6*a*	15	20	36	1,300	46,800		
	b	25	30	24	2,100	50,400		
III.	5*a*	35	40	40	2,600	1,04,000	2,72,000	27,200
	b	25	30	20	2,100	42,000		
	2*b*	25	30	20	2,100	42,000		
	a	25	30	40	2,100	84,000		

The yield after the second revolution would then be uniform for each period, namely, 2,52,000 cubic feet, yielding an annual income of 25,200 cubic feet.

(To be continued).

BUTEA FRONDOSA.

CAN the Editor of the "Indian Forester" or any of its readers inform me whether a variety of palás (*Butea frondosa*) in no way differing from the ordinary tree, except in the colour of the flower,* a pale yellow, is common in any part of India? I have lately come across a few specimens, and find no mention of the variety in Brandis' work.

K.

MALE FLOWERS OF DEODAR.

I SEND two catkins which I have to-day observed; these appear to be at least a week old, so that the date of earliest appearance varies in different years. Last year it was 26th June (as already reported in the "Forester"), this year it must have been about the 13th. Will other officers correct any errors in my table from time to time?

J. C. McD.

STEEL SLEEPERS.

THE French Government has hit upon an altogether unexceptionable method of encouraging the native iron and steel trades. It has been determined to discard the use of wooden sleepers on the State railways, and to gradually substitute the metal ones which are coming into extensive use on the Continent, as in India and our Colonies. In Germany they are in high favour, since, although the first cost is greater, they are found to be more durable than wooden ones. The Minister of Commerce is inviting tenders for 25,000 steel sleepers to begin with; but it is calculated that 4,300,000 of them will be required every year for fifteen years before the whole of the existing mileage will be replaced. At present prices this means an expenditure of £1,600,000 per annum upon steel: a prospect which will ravage a good many people on the side of the present Government. We do not know that any fair trial of metal sleepers, whether of iron or steel, has yet been made in England; but in the melancholy position of our iron trade, it is very desirable that some experiments should be made. It is almost inevitable that within twenty years metal will be exclusively used for this purpose, since the timber supply of the world is being rapidly exhausted. The American forests, indeed, will probably not last another twenty years.—*St. James Gazette.*

* Varieties in colour of flowers of the same species frequently occur. If "K" would kindly send well preserved specimens to the Forest School Museum, we should be much obliged.—[ED.]

JJ Reviews.

FOREST CONSERVANCY IN MADRAS 1884-85.

The reports of the two Forest Circles of the Madras Presidency for the year 1884-85 fill a volume of portentous size, containing 342 pages as follows :—

	No. of pages.
Report of Southern Circle, ...	70
Appendices „ „	135
Report of Northern Circle, ...	37
Appendices „ „	89
Review of Board of Revenue and orders of Government, ...	11
Total, ...	342

The Government order draws attention to this as follows :—

"Government are fully sensible of the fact that it may be desirable, for convenience of reference, that the detailed records of the Forest Department should be printed yearly, but the administration reports should not, on this account, be burdened with unnecessary matter. All that is required is a concise summary, by each Conservator, of the salient features of the administration of his division, together with a brief notice of any matters of exceptional interest."

It is an open question, and we hear it was at one time proposed for the Punjab, whether it would not be an advantage that the District Forest officers should submit printed reports to their Conservators, who could then readily write the concise summary of forest administration required by Government, whilst the District reports would remain as permanent records for reference, and this would evidently enable the Collectors to form a much clearer idea of the work going on in their districts, than the present system. From Mr. Gamble's forwarding letter to the Secretary to the Madras Board of Revenue, dated the 7th July, 1885, we find that even the Conservator's reports are submitted in manuscript, and that it is considered a favor, if the proofs are returned to the Conservator for correction

* Progress Report of Forest Administration in the Madras Presidency 1884-85, with a review by the Board of Revenue and orders of the Government of Madras.

Owing to the hurried manner in which the reports were required to be prepared, Mr. Gamble had no time to embody his intended remarks on the results on fire-protection, and yet the reports were not reviewed by the Board of Revenue till the 6th of November, 1885, nor by the Government till the 30th March, 1886.

Surely the Conservators might be allowed more time to send in properly corrected and printed reports, as is now done by all Conservators under the Government of India.

One of the reasons for the inordinate length of the appendices is that the table of area of reserved and other forests, which only fills 2 or 3 pages for each of the Circles of the N.-W. Provinces, comprises 44½ pages for the two Circles, many of the reserved areas being of insignificant size.

There is also an annual list of village topes, mostly of mango and palmyra trees, which fills 41 pages, instead of which Colonel Walker proposed simply to report any additions or exclusions made during the year, and that the list having been once printed in an annual report should be kept written up in the Conservator's office. The store list of the Southern Division alone fills 12 pages, and need not be given in detail if proper lists are kept up in the Conservator's office.

Mr. Gamble gives two valuable lists of trees and shrubs for the ceded Districts about Cuddapah and for the Northern Circars, which occupy 29 pages of his appendices, and which we hope are available separately.

During the year the Madras Forest Code has been brought out, but as we have not yet received a copy, we are unable to compare it with the new Forest Code of the Government of India. Certain rules to regulate the powers of Forest officers and for the control of timber trade have been promulgated, but the latter have been considered too sweeping in character, and are now under reconsideration. The following statement gives the areas of the reserved forests:—

	Southern Division.		Northern Division.		Remarks.
	1884.	1885.	1884.	1885.	
	sq. m.	sq. m.	sq. m.	sq. m.	In the Northern Division 262·5 square miles of leased forests in Sandur and Mudumalai are declared to be reserved forests.
Under the Act, ..	683	1,113	...	7·5	
Prior to the Act, ..	1,363	1,040	824	819	
Total, ...	2,046	2,153	824	826·5	

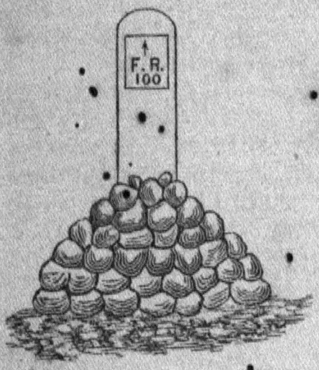
So that it will be seen that little progress has been made during

the year, and this is explained as owing to the want of a special Forest Settlement officer for the Northern Circle.

Considerable progress has been made in demarcation work in both Circles, and Rs. 23,063 having been spent on this important work. It is not quite clear what the average cost of the work is, but it is given at Rs. 11-8 per mile for Ganjam in the Northern Circle, Rs. 3-8 in Madura, and Rs. 103 in Kurnool.

The following extract and diagram explains the kind of pillar erected in the boundary of one of the reserves in Madura :—

"The erection of a post about 7 feet high and 6 to 9 inches in diameter firmly driven into the ground at necessary points, and having near the top a cut surface bearing the Government broad arrow, the letters F. R. and a number. The post is protected by having stones piled round it to a height of about 3 feet."



It is to be hoped that the posts are of heartwood, and not liable to the attacks of white ants, or they will prove of very temporary duration.

As regards survey we read that arrangements are now under consideration for the execution of forest surveys under competent professional supervision as a branch of the Revenue Survey Department.

It is evident that until the demarcation of the reserves is completed and good maps are provided, that working plans of the Madras forests cannot be undertaken, but in the Northern Circle a few plans for fuel coppices in the Nilgiris have been prepared, and rough schemes for the Mudumalai and Sandur leased forests and for the Nellore casuarina plantations have been prepared. An account of a working scheme, prepared in 1883 by Mr. Gass, Deputy Conservator of Forests, for the Coonoor peak *old plantation*, with an excellent map, is given as an Appendix to the report of the Northern Circle.

It is an area of 206 acres divided in 40 compartments, which was at first worked as a coppice, but is now to be worked as a high forest with a system of 10 year thinnings, and the period of rotation is not yet fixed for the high forest, but it is assumed that 60 years will suffice.

The plantation appears to be composed of *Acacia melanoxylon* and *Eucalyptus obliqua*, *calophylla*, *piperita* and other species, but no clear account of the standing crop is given.

The following general prescriptions give an account of the procedure proposed :—

"Each compartment to take not more than 1½ months to cut and

remove the wood to the road side and to clear away the brushwood and round off the stools ready for coppice reproduction. During the first coppice rotation, at least 400 standards to be left per acre evenly distributed. If 600 are left, so much the better. Shelter belts of at least three trees thick to be left on the edges of compartments and along roads wherever danger from wind is anticipated.

"During the second coppice rotation, 1894 to 1903, the number of standards may be reduced to 300 per acre, and at further rotations they will gradually be still further reduced, until at the end of the sixth period, there are about 40 to 60 per acre, which, so far as we can tell at present, will constitute a fully-stocked high forest of big timber.

"This scheme is, of course, liable to revision at any time, and especially if the demand for fuel very largely increases do we recommend the standards being cut and the system altered to 'Simple coppice,' which we feel to be the system most profitable to adopt for fuel works.

"Every third and sixth year, the compartments under reproduction should be thinned—lightly the third, more heavily the sixth,—and blanks in the coppice should be regularly filled up by planted seedlings. The indigenous growth should be allowed to grow up when the saplings are good, so as to help to form a complete mass capable the better of resisting wind."

In 1883 two compartments with an area of 7·3 acres were cut as simple coppice, and yielded 1,700 tons of fuel, or 233 tons per acre.

The coppices in the Nilgiris referred to by Mr. Gamble yielded respectively 92·7, 108·4 and 125 tons per acre. It is a pity that the species of trees in these coppices are not given in the report.

Regarding the prosecutions we give the following extract from the Government order, and note that in the N.-W. Provinces the number of cases compounded by Forest officers under section 55 are kept quite distinct from those tried by Magistrates.

"The following statement shows the number of prosecutions for breaches of forest rules for the years 1883-84 and 1884-85:—

Division.	Year.	Number of cases for disposal.	Disposed of.			Percentage of column 4 to column 6.
			Convicted.	Acquitted.	Total.	
Northern, ..	1883-84,	606	425	96	521	81·5
	1884-85,	845	602	165	767	78·0
Southern, ..	1883-84,	588	449	114	563	79·5
	1884-85,	1,031	513	310	823	62·0

"The increase in the number of prosecutions is probably due to improved detection and not to any increase in the number of offences committed. The Conservator, Southern Division, states that the apparently large proportion of acquittals in his division is due to the

inclusion under the head 'acquitted' of a large number of cases which were compounded under section 55 of the Forest Act. The working of this section calls for the exercise of considerable discretion and care."

Regarding fire protection, we give the following extract from the review by the Board of Revenue:—

"There was a marked improvement in both divisions in the area protected from fire during the dry season of 1884-85. The following statement compares the area and cost with the corresponding figures for the previous year:—

Year.	Division.	Area attempted.	Failures.	Percentage of failures to area attempted.	Cost of Protection.	
					Per square mile in Rupees.	Per acre, in Pies.
		sq. m.	sq. m.			
1883-84, ..	North, ..	370·4	29·5	7·96	15·7	4·7
	South, ..	530·5	6·7	1·26	7·0	2·1
	Total, ..	900·9	36·2	4·01	10·5	3·1
1884-85, ..	North, ..	720·5	23·6	3·27	15·5	4·6
	South, ..	744·8	14·0	1·88	15·6	4·6
	Total, ..	1465·3	37·6	2·56	15·5	4·6

"There is apparently a large increase in the cost of protection in the Southern division, but this is due to the abnormally low figure for 1883-84, resulting from the fact that all expenses incurred on the work were not debited during the year, and that large areas of naturally protected jungle and plantation were included."

The Board do not place much reliance on the figures given by the Conservators as regards the areas of forests which as a rule escape fire without any special protection, and which are admittedly far from accurate. These are given at about 7,400 square miles for the two Circles.

Colonel Walker states that there is nothing to show whether certain areas escape fire regularly through a series of years or not, and that his officers have too much on hand to attempt to record such details.

Mr. Gamble has, however, noted for the Northern Circle, that the following classes of forest usually escape fire:—

	Square miles.
Plain forest in Ganjam, ...	100
Rékapalle Hills on the Godávari, ...	300
Kistna and Nellore Coast forests and plantations, ...	260
Ceded Districts (babúl forests), ...	1,000
Cuddapah, ...	3,000
Nilgiris, *shólas*, ...	200

Both the Conservators state that the fire season is most variable in Madras, and we quote the following interesting remarks by Mr. Higgens, C.S., District Forest officer of Cuddapah:—

"In some years when a heavy south-west monsoon producing a large crop of grass has been succeeded by a light north-east monsoon, the fire season may begin in February, and, if timely rain does not fall, continue till August, and a very small proportion of the forest may escape fire. In other years, like the season 1884 to 1885, when a light south-west monsoon, producing little grass, is succeeded by a heavy and late north-east monsoon, the fire season may not begin till April, and may be over, if the rain comes seasonably, by 15th June. In the latter case, the proportion of the forest area which is not burnt may be three-fourths of the whole, or even more."

Colonel Walker also remarks as follows:—

"The practice of maintaining separate accounts for fire-protection up to the 15th June is apt to cause confusion and inaccuracy. It was adopted in order to assimilate our returns with those in other provinces, but really in Madras the fire-season is no more over on 15th June than it is on the 31st March, and in the districts not subject to the south-west monsoon, the forests are often not safe against fire till October or even later. It is, therefore, for consideration whether our fire-protection accounts had not better be closed on 31st March like others, and the returns made applicable to the financial year, instead of to a special year ending on the 15th June. Definite proposals to this effect are contemplated."

The total grazing revenue is Rs. 49,236, of which only Rs. 8,227 comes from the Southern Circle.

The question of regulating grazing in the Madras forests is still under consideration, and in some districts free grazing is allowed, in others a small fee charged, whilst cattle are rigorously excluded from some of the reserved forests.

That the settlement of the question is of the utmost importance to the future of the Madras forests the following quotations prove conclusively. Colonel Walker speaks of

"The serious damage done to the once splendid forests on the Anamalais, either through want of knowledge on the part of so-called pioneers of forestry, or the failure on the part of the Government of the day to recognize that annual fires and unrestricted grazing, coupled with felling all the good trees and leaving the bad ones, must sooner or later ruin any forest."

And regarding the Trichinopoly unreserved forests we read that—

"No good results can be expected in the way of natural reproduction with 407,246 head of horned cattle and 884,147 sheep and goats allowed to graze and browse without restriction. The District Forest officer calculates that this represents two head of horned cattle and four goats or sheep to every acre of Government waste, but gives no data for his estimate, which the Conservator is

unable to verify. The District Forest officer instances the Viramalai Hill, in Kulitalai Taluk, the eastern slopes of which have been nearly denuded by the indiscriminate cutting and hacking of trees by herdsmen for the sake of leaves for their cattle during the hot season when they are driven there for pasture."

Mr. Gamble has made some interesting remarks under the head of natural reproduction, and concludes as follows :—

"The Conservator desires to put on record his experience of the wonderful powers of reproduction of the Konda Tangedu (*Xylia dolabriformis*) in the forests of the Upper Godávari and Rumpa. Whether under shade or in the open, seedlings are everywhere most abundant where the grazing is light, and he thinks that except perhaps the sál, he knows of no Indian tree whose new growth can be so easily obtained as that of the ironwood. It would be a thousand pities if the immense and valuable ironwood forests of the Rumpa country were to be carelessly destroyed unless it be for permanent cultivation."

The area of plantations in Madras and their cost up to the 31st March, 1885, is as follows :—

	Regular Plantations.		Cultural operations.		Topes.		Total.	
	Area, acres.	Cost, Rs.	Area, acres.	Cost, Rs.	Area, acres.	Cost, Rs.	Area, acres.	Cost, Rs.
S. Circle, ...	12,322	10,25,264	1,979	26,854	18,238	2,42,131	32,534	12,94,249
N. Circle, ...	6,624	3,90,568	265	2,234	13,161	1,00,966	20,050	4,93,768
Total, ...	18,946	14,15,832	2,244	29,088	31,394	3,43,097	52,584	17,88,017

Some of the plantations have already given some returns, as those of Coonoor 1,373 acres, which cost Rs. 54,304, have given a total revenue of Rs. 66,640 up to date.

No general statement of the yield of the plantations for the province is given however.

The average cost per acre of the regular plantations in the Northern Circle has been Rs. 60 per acre, and Rs. 83 per acre for the Southern Circle.

We are rather left in the dark as to the object of the plantations in Madras and the species of forest trees planted, and village topes and roadside trees and regular forest plantations are treated of in the same paragraphs in the report of the Northern division in a somewhat confusing manner. If the plantations could be classified as

Casuarina fuel plantations,
Teak plantations,
Australian exotic plantations in the Nilgiris
Various,

and some account given of the cost, yield, rate of growth, &c., for each class, the chapters on artificial reproduction would be much more interesting to the general reader.

The District Forest officers in the Northern Circle appear to have confused ideas of what the Code means by *cultural works of improvement*, as clearing boundary lines, opening experimental fuel depôts, preparing working schemes, construction of rest houses, &c., &c., are shown under this head.

Some climber cutting has been done, but it is evident that forest conservancy in Madras must be more advanced before regular works of this kind can be generally undertaken.

In the Northern Division, the only works referred to are sowings and plantings in certain forests, and a little climber cutting at somewhat high rates, 168 acres for Rs. 122, in the Cuddapah forests.

Mr. Vincent, District Forest officer of Nellore, reports that dry sandy areas which were fenced only two years ago, and were then bare for nine months out of the twelve, are now covered with grass, while seedlings of *Albizzia amara* are coming up.

As regards experiments with exotic trees, we read that it is proposed to plant mahogany as standards in teak coppice at Nilambar. We read that Divi Divi, *Cæsalpinia coriaria*, is growing well at Madura and other places. *Pinus kasya* and *Pinus insignis* do well in the Nilgiris, and hundreds of plants of *Acer Campbellii* and *lævigatum* have been put out. *Rhus vernicifera* seed has germinated in the Nilgiris.

The following statement shows the progress of some of the largest mahoganies in Nilambar, where there are 3,000 trees, 1,000 having died since last year :—

When planted.	Number.	Height when planted.	Measurement in April 1884.			Present Measurement.		
			Height.	Circumference.		Height.	Circumference.	
				At base.	Five ft. up.		At base.	Five ft. up.
		in.	ft.	in.	in.	ft.	in.	in.
September 1873, ...	1	situ.	67	47	34½	67	50	37
June, 1878, ...	2	6	27	19	15	28	20	15½
....	3	6	18	13	10	...*	...*	...*
October 1879, ...	4	6	18	11	8	19	11½	8
....	5	6	18	10	8	19	12½	9½
....	6	6	19	14	8½	20	15½	10½
....	7	6	19	12½	8½	21	12½	9
....	8	6	18	10½	11½	20	16	12½
....	9	6	17	10½	7½	18	12	10

* Died.

Date planted.	Number planted alive.	Number measured.	Height when planted.	Measurement in April 1884.			Present Measurement.			Remarks.
				Height.	Girth at base.	Girth 5 feet up.	Height.	Girth at base.	Girth 5 feet up.	
					Ceara or *Manihot Glaziovii.*					
			in.	ft.	in.	in.	ft.	in.	in.	
		1	30	36	36	21	37½	37½	22½	Double top tree.
						..			..	
						21½			23	
October 1878, ..	4	2	20	33	32	28	37	35	30	
		3	20	34	24½	20½	38	20	21	
		4	20	35	23	18½	35	24	19	
		5	40	32	23½	19½	35	25½	21	
June 1880, ..	42	6	40	34	23½	18½	36	26½	20	
		7	40	33	26	23	37	34	26½	
September 1880, ..	..	8	situ.	28	32	24	32	34	26	
July 1881, ..	57	9	28	35	25	21	39	28	23½	
		10	28	37	22	19	41	26½	23	
					Hevea braziliensis.					
		1	30	38	19	11½	39	22½	11½	
		2	30	37	20	12	40	24	14½	
June 1879,	28	3	30	33½	19½	12½	38	23	15½	
		4	30	34	19½	12	37	23	14½	
		5	30	34	19	9½	36	20	12	
					Castilloa elastica.					
		1	36	10½	9	6	11½	9½	6½	
June 1880, ..	8	2	30	19	16½	13	22	17	13½	
		3	18	19½	19½	16	26	21½	17½	
		4	9	5	..	..		6	..	
August 1882, ..	3	5	9	3½	..	..	4½	..	..	
		6	23	6	7	..	9	10	4½	Rooted cutting.

Regarding the caoutchouc yielding plants we read as follows :—

"*The South American Indian Rubbers.*—The District Forest officer, Malabar, remarks that these are no longer experiments, having now established themselves well enough, and doubts whether their cultivation would pay at all. Trees seven years old yield very little milk when tapped.

"The *Cearas* planted in 1878-80 and 1881, seeded as in the previous year, and about 200 seers of seed were collected. Self-sown seedlings are coming up freely in the exotic plantation.

"The *Hevea brazilienses* and the *Castilloas* are flourishing. The latter flowered in the beginning of February, but all withered away shortly after. Measurements of a few of the best plants are given in the preceding table.

"*Landolphia florida.*—The one plant of this referred to in the last report as received from Ceylon has grown to a height of 6½ feet."

A good deal of work has been done under the head of roads and buildings, the total expenditure for the two Circles being as follows :—

	Rs.
Roads, ...	28,767
Buildings, ...	28,445

The following figures show the yield of the Madras forests during the year :—

	Timber.	Fuel.	Bamboos.	Minor produce.
	c. ft.	tons.	No.	rds.
Collected, ...	238,317	14,808	44,192	13,063
Sold in forests, ...	21,458	3,670	1,559	2,104
Sold at depôts, ...	138,086	5,296	6,437	6,716
Otherwise disposed of at depôts, ...	28,630	140	...	38

but it is not shown what is removed by departmental agency, and what by private consumers, though such a statement is promised for next year's report.

The following extract from the Government order shows what has been done in timber works :—

"Felling operations were considerably restricted in the Southern Division, except in Malabar, where extensive fellings of teak were made. The total quantity of teak felled in the Southern Division was 64,908 cubic feet and 38,548 saplings, against 38,191 cubic feet and 63,712 saplings in the previous year. The chief collections in the Northern Division were of red-wood, sal, and firewood."

The only important item of minor produce is the bark of tangedu (*Cassia dalabiformis*?) from which a revenue of Rs. 18,796 was apparently derived.

We also extract the following from the Government order:—

"Free permits were, in most districts, granted to agriculturists, but it is hoped that this system, which is open to many objections, may soon be rendered unnecessary by the constitution, throughout the Presidency, of village forests."

Regarding village forests, we read as follows from Mr. Gamble's report:—

"*Village Lands.*—The village lands under Rule 7 of the Forest Rules have been selected and set apart in one locality only, *viz.*, the Merkunád amshom of the Nilgiri District. The arrangements were made under the special supervision of Mr. R. S. Benson, C.S., who was both Revenue and Forest Settlement officer, and the rules which he prepared, and which were approved by Government, are herewith given:—

"*Subsidiary Rules under Rule 7 of the rules framed by the Governor in Council under Section 26, Act V. of 1882.*

"The Government forest lands mentioned below have been set apart by the Collector in the village of for the benefit of the villagers of that village.

"2. The indigenous villages (*i.e.*, Badagas, Kotas, Irulas, Kurumbers and Todas) may gather dry wood for their own use only in all these lands, free of charge. Such fuel may not be sold or bartered.

"3. The Monegar of the village may grant to any indigenous villager (as above defined) a free pass to cut timber for his own use for building or agricultural purposes in any of the above lands. Such timber may not be sold or bartered.

"4. The Monegar shall keep a free pass book (which will be supplied by the Deputy Tahsildar), and shall enter in the pass and in the counterfoil thereof—

(1). The name of the person to whom the pass is granted;
(2). The shola in which the wood is to be cut;
(3). The purpose for which the wood is required;
(4). The date on which the pass is granted;
(5). The date on which it expires.

"If the Monegar is unable to write, he may have the entries written by the Curnam.

"5. The Monegar is responsible that the timber is really required and is used for the purpose stated in the pass, and that reserved trees are not cut.

"6. The Revenue Inspector and the Forest Ranger on their tours shall inspect the counterfoils of the free passes, and shall, after so doing, write on them their initials and the date of their inspection. If the Revenue Inspector or the Forest Ranger has reason to think that the privilege is being abused, or that these rules are being broken, he may make inquiries, and, if necessary, report the facts to the Deputy Tahsildar or superior Forest officer.

"7. If any person cuts timber without a pass, or in excess of the allowance named in the pass, or cuts any reserved tree, the Monegar shall report the case to the Deputy Tahsildar, in view to the prosecution of the offender under the Penal Code for mischief or theft, as the case may be.

"8. The following are reserved trees:—(Here list as in Rules.)
"It is to be hoped that the work will soon be taken in hand in all districts. Meantime no restriction that the Conservator knows of is being placed on the exercise of previously-conceded privileges."

We read that the Madras Forest Department was well represented at the Forestry Exhibition in India, and that a number of medals and diplomas were awarded to the officers. Colonel Walker visited the exhibition, and purchased a Giant Riding Saw Machine which is to be tried in North Arcot.

The following table compares the financial results of the working of the department during the last five years:—

Year.	Receipts.	Charges.	Surplus.
	Rs.	Rs.	Rs.
1880-81, ...	7,21,769	5,21,453	2,00,316
1881-82, ...	8,05,884	6,03,069	2,02,815
1882-83, ...	9,03,914	6,36,558	2,67,356
1883-84, ...	9,58,991	7,80,916	1,78,075
1884-85, ...	11,62,089	8,84,421	2,78,268

There can be no doubt that, as compared with other provinces in India, with her tropical climate and the immense area of forests, from which reserves are being selected, and proximity to the seaboard, and a teeming population, that Madras will soon outstrip many provinces which have had the start of her in forest conservancy.

We hear with regret that the establishments suffered severely from fever, exposure and overwork, and Colonel Walker's remarks on this subject apply to forest work in other provinces as well as Madras.

"Everything is being done by erecting good rest-houses, providing warm clothing and medicines, and sinking wells, to reduce the dangers and discomforts of forest life; but the work naturally entails constant exposure in all climates and seasons, and our officers in the subordinate grades cannot afford to live well enough to enable them to resist or throw off attacks of fever and other diseases."

Mr. Gamble's description of the upper Godávari and Mudumalai forests is sufficiently interesting to be given as it stands in the report.

"*Description of the Forests.*—The character of the forest depends chiefly on the prevalence or not of hilly country. The eastern edge of the taluk is occupied by a range of hills, which rises in places to 3,000 and even 4,000 feet, and occupies an irregular strip, of which the base is on the Godávari; one side on the Rumpa frontier and the other the foot of the hills. The average breadth of this strip is 6 miles, and the length about 33 miles, so that the area may be

said to be about 200 square miles. In this strip the principal tree is the ironwood (*Xylia dolabriformis*), hitherto, so far as I can ascertain, considered of no account. The ironwood tree, better known perhaps under its Burmese name of 'Pynkado' and its Malabar name of 'Irul,' is really a most valuable tree. It has a hard, dark-red, very durable wood, is capable of being used for sleepers, for buildings, bridges, &c., and is in some localities much employed for telegraph posts. Where the sál forests of the Circar Hills end, there the ironwood begins—a most fortunate circumstance, though we may regret that neither of the trees have hitherto received sufficient attention in this Presidency. To show that the ironwood supply may be utilized as a source of revenue, I would mention that, from information afforded by the office of the Inspector-General of Forests at Calcutta, 'Pynkado' or ironwood sleepers from Burma are now being sold in Calcutta, *ex* steamer, at Rs. 4-12-0 each for broad, and Rs. 1-15-0 for narrow, gauge. One of the most remarkable and valuable characteristics of the ironwood forests of Rékapalle and Rumpa is the abundance of reproduction; seedlings may be seen everywhere, under dense shade and in the open, and there can be little doubt that the forests can be treated in a systematic manner more easily than almost any other kind in India except perhaps sál. The valleys of this range of hills contain huge trees of *Terminalia tomentosa*, *Arjuna* and *Belerica*, *Anogeissus latifolia* and *acuminata*, *Lagerströmia parviflora*, *Bombax malabaricum*, *Dalbergia latifolia*, *Dillenia pentagyna*, *Albizzia procera*, *Stereospermum suaveolens* and *chelonoides*, *Odina Wodier*, *Garuga pinnata*, *Adina cordifolia* and mango among others, and in some places teak. The largest tree of teak that was seen was near Perakonda, and measured 7 feet 5 inches in girth, but such trees are very scarce indeed. To give an idea of the size to which timber grows in this great hill range, the following measurements of large trees taken in one valley may be recorded:—

	Girth at 4 Feet.	Height.
	ft.	ft.
Anogeissus acuminata, ...	16	150
Terminalia tomentosa, ...	12½	120
Do. Belerica, ...	7½	100
Bombax malabaricum, ...	12½	120
Dillenia pentagyna, ...	8½	100
Dalbergia latifolia, ...	6	80
Lebidieropsis orbicularis, ...	5½	50
Garuga pinnata, ...	7¾	100

"Under these trees, the chief growth is that of the big thorny bamboo (*Bambusa arundinacea*), and there is a very considerable amount of timber, which only requires better communications to enable it to be brought to the river for rafting to the delta.

"The hill slopes are covered with good forest also, though naturally the trees are not so good. With the ironwood trees are chiefly found *Anogeissus latifolia*, *Lagerströmia parviflora*, *Dillenia pentagyna*, *Lebidieropsis*, *Schrebera swietenioides* and other kinds rarely reaching, or likely to reach, more than about 4 feet in girth, but capable of producing timber of and below that size—the size most in demand for the native buildings of the delta. With these

are quantities of the male bamboo (*Dendrocalamus strictus*). In the deep shady valleys, of course, a different vegetation occurs. *Diospyros Embryopteris*, *Canthium didynum*, *Bursera serrata*, are the chief trees along the watercourses, and the toon (the *Cedrela Toona*) may be found, for though I did not meet with it in Rékapalle, I found it in Rumpa. *Heterophragma Roxburghii* is also not uncommon.

"The number of villages within this hill tract of about 200 square miles, omitting those on its outer edge who sometimes cut 'podu' on the hills near them, is about fifteen, of which five at least on the Godávari are demarcated and may be excluded from calculation. The remaining ten Reddi villages, cultivating usually only 'podu,' cut yearly about 20 acres each and cultivate for three years, then leaving fallow for twelve years. The amount of land yearly required is therefore about 800 acres—a very small amount compared to the total area.

"The only other hill ranges east of the Saveri are—

(1), Walsugri Hill, south of Rékapalle.

(2), The low range between the Silér and Sokalér rivers.

These resemble in character of forest the great Rékapalle range: though, as they have been more cut in 'podu,' the forest on them is smaller.

"West of the Saveri River lies the big isolated range which we may call the Rapak Hills, which contain about 40 square miles. It is in and about this range that the teak is chiefly found; indeed, could it be so arranged that the 'podu' cultivation should stop, it would not be very difficult to convert the whole in some fifty to a hundred years into a forest of fairly compact teak. But the Rapak Hills are full of villages (twelve at least, and these large Koya villages), they are covered with 'podu' cultivation, and the question of what is to be done may be postponed. Two of Mr. Boileau's reserved forests have already taken the best parts, and my own present proposals will add the slopes which are available and give us teak forest to the east and west, and I think this should suffice. So far as I could judge, the people are very careful not to cut teak in the 'podu.' I saw no signs of felled teak anywhere, and if they can be persuaded to go a step further and keep the cut material away from the teak trees when they burn their 'podu' fields, there will gradually be a fine stock of teak produced for the future on the slopes of the Rapak Hills with no present interference.

"Of other hills, there are few of any importance. The south slope of the Narakonda Range, the north of which is in Bustar, is also considerably cut in 'podu' and is rocky, but should be preserved to prevent its being denuded, and the one or two villages at its foot who at present cut 'podu' might be allowed to continue to cut a fixed area until Government stops the style of cultivation.

"The forests of the plains differ chiefly according to soil. Along the banks of the Godávari and Saveri, there is a broad stretch of what I presume is pure 'black cotton soil' only about half of which can be said to be cultivated for the growth of cholum. Further inland, there are parts in which the soil is poor, consisting of decomposed ferruginous conglomerate somewhat resembling laterite, while in others there is good loam, and on this the villages are chiefly situated. On the black cotton soil, curiously enough, the chief tree

is teak, and in this way near both Kunavaram (the Special Assistant Agent's head-quarters) and Dumagudem, there are good patches of teak poles—the result of 'podu' cultivation in which the teak has been systematically left. On the stiffer soils the acacias predominate, *viz.*, *Acacia leucophlæa*, *eburnea* and *arabica*, with wood-apple and tamarind near villages.

"On the poor shingly soils and the kunkur and hard ferruginous clay beds among them, the chief trees are the *Soymida febrifuga*, *Xylia dolabriformis* and *Chloroxylon Swietenia* with *Acacia Catechu* and a few other trees, while in the ravines and along water-courses a dry evergreen growth is met with that reminds one of Cuddapah and Nellore, and in which the principal trees are *Mimusops hexandra*, *Memecylon edule*, *Maba buxifolia*, *Pleurostylia Wightii* and *Diospyros Chloroxylon*. Here sometimes the Mimusops grows very large, and one tree 8 feet 8 inches in girth, with a height of about 80 feet, was met with near Darapali. The Soymida trees frequently grow to 6 or 7 feet in girth, but the Satinwood is generally small, owing to the custom of cutting it young for rafters.

"On the better soils and the undulating country the regular plains forests occur, and in these the *Terminalia tomentosa* is the principal tree. It is, however, supported by others such as *Xylia dolabriformis*, *Lagerströmia parviflora*, *Bassia latifolia*, *Soymida febrifuga*, *Pterocarpus Marsupium*, *Adina cordifolia*, *Acacia Catechu*, *Anogeissus latifolia*, *Schrebera swietenioides* and teak here and there in patches. Ebony (*Diospyros Melanoxylon*) should be noticed especially, for in some localities it grows very well and of very large size. Several were seen that measured 8, 10 or even 12 feet in girth. A valuation survey made in by no means a good locality close to the Central Provinces frontier gave per acre—

Tectona grandis, ...	16
Pterocarpus Marsupium, ...	4
Dalbergia latifolia, ...	2
Terminalia tomentosa, ...	22
Xylia dolabriformis, ...	15
Lagerströmia parviflora, ...	14
Soymida febrifuga, ...	2
Adina cordifolia, ...	2
Ebony, *Anogeissus* and *Chloroxylon* (about), ...	40
Total, ...	117

"The following note is also extracted from the Conservator's report on the Mudumalai forests in the Nilgiris:—

"The *Mudumalai forests* are a fine property, covering 200 square miles, and of much better growth than I had expected to find. Almost everywhere in the western portion, teak is common, with *Pterocarpus marsupium*, *Schleichera trijuga*, *Shorea laccifera*, *Terminalia tomentosa*, *paniculata*, *Chebula* and *Belerica*, and in the valleys blackwood (*Dalbergia latifolia*). Bamboos are very good also, both the large or thorny kind (*Bambusa arundinacea*), which occupies the valleys, and the small or male bamboo (*Dendrocalamus strictus*), which is found on the drier uplands. In the ravines, the teak is capable of very fine growth, and although, as may be ima-

gined, there are few sound trees of large size, yet there is a fair amount of good half-grown timber, and under protection from fire and with careful management, including the cutting away of useless trees, a good young growth will come up. On the higher lands, the forest has suffered so much from fire that there is in most parts only a poor growth, but there are in places good poles of young teak about one-quarter grown, and the numerous seedlings and coppice shoots show that only protection is wanted to convert the forest into a valuable property."

FORESTRY AT THE CAPE.

THE report of the Superintendent of Woods and Forests for the year 1884 submitted (anonymously) to both Houses of Parliament by command of His Excellency the Governor of the Cape of Good Hope, is a very little report with a very long tail. It consists of a page and a half of general remarks, presumably by the Superintendent, but without any signature, and sixty-one pages of "annexures."

Officials in India think it is necessary to embed the reports of subordinates in a *matrix* of official phrasseology of their own or their office before submitting them to a higher authority. In the Cape they run a thread through them and drop them into the post-bag, which is much the simpler plan.

The Cape Forest Report consists then of some five or six reports, bound together, from Forest officers varying in rank from Conservator to Ranger, who appear to hold charge of independent circles in various parts of the Colony. Each officer has followed his own sweet will in the arrangement of the subjects treated by him; and there are, apparently, no prescribed statements or annual returns of any sort. The first to report, the "Superintendent of Plantations" is of opinion that the work under his control naturally divides itself into three heads, *viz.*, afforesting of Crown lands; distribution of plants and seeds; general conservancy. The second and third reporters, *viz.*, the Conservator of Forests, Knysna, and the officer in charge of the Hymansdorp forests have no pronounced opinions on the subject, and merely submit, with some general remarks, statements of timber felled in their forests. The fourth "annexure" is much more elaborate and forms the bulk of the volume. It reads like a very excellent report, of which the paragraphs had got mixed in the press. Beginning with *general remarks*, it goes on to *mountain forests, survey, demarcation and settlement, re-organization of forest establishment, nursery list, reforesting, Indenge oak, mean yearly increments, form of cultivators' permits, forest cases, forest law, reserved forests, marking timber; passes for firewood, Police powers, power to seize, cutting and removal, goat grazing, compounding forest offences, timber trees, forest fires,*

Police and Forest Departments, roads, building and fencing, line cutting, and so on.

The report of the fifth officer, which is shown in the *index* as an independent annexure, is appropriated in annexure IV as an Appendix. We may therefore neglect it and its method of disarrangement.

We are unable to gather from any of these reports a clear idea of the position the Forest Department in the Cape holds in the general administration, or the areas or resources of the forests administered. The writers of the "annexures" doubtless left the duty of explaining these matters to the Houses of Parliament and others to the anonymous individual, the phantom spirit, who presides over the Cape woods. The following extract, which comprises nearly one-half of what the Superintendent of Woods and Forests is pleased to call his report, will show the broad grasp he takes of the requirements of Cape forestry, and the vigour and closeness of his reasoning. The italics are ours :—

"During the year under report, clear evidence has been received of the value of Colonial Woods. Well prepared and properly exhibited, they have gained the highest awards at the Edinburgh Forestry Exhibition. Immediately following this success, an order for Stinkwood logs was received at Knysna from London, and enquiries have been made to the Honorable the Commissioner of Crown Lands and Public Works for samples of wood suitable for engraving purposes, fishing rods, and weaver's shuttles.

"It is well known, *on the other hand*, that wood used without proper precautions in felling and seasoning, has no good qualities, and is of little practical value; also that forests worked without order are quickly exhausted and finally ruined, without any adequate profit. In order that wood may be properly prepared in the future, I have collected all the information possible as to the characteristics of sound and of defective woods; the faults and blemishes to which they are subject; and shown how wood should be properly inspected. I have fully discussed the question of the most suitable season for felling, and detailed the precautions which should be taken in drying. From all this information I have compiled a treatise with the intention of making known and popularising the proper conditions which should be fulfilled in order to procure good sound wood.

"Tables for rapidly calculating the cubic contents of trees standing, or felled—round, or squared, have also been prepared.

"All the information relative to the successful progress of forest work has been collected, *so that we may be assured of finding in the forests, in perpetuity, much larger quantities of wood than has heretofore been taken from them*, even in the years when the greatest numbers of licenses have been issued."

As we read on, however, we obtain from the annexures interesting glimpses of colonial and forest life. Planting and other operations appear to be carried on largely by convict labour. Thus the Superintendent of Plantations reports :—

"Towards the close of the year the Honorable the Commissioner of Crown Lands and Public Works visited the Plantation, and seeing the success attained he has been pleased to augment the operations by convict labour. This step has given great impetus to the work.

"Mr. Johnston, who was in charge of the Convicts, has been appointed Superintendent of the Porter Reformatory, and the ability and attention with which Mr. Harman conducts his plantation work has been recognised by giving him an increase of salary and combining his appointment as Forest Ranger with that of Acting Superintendent of Convicts. The plan of combining the two offices works well, and it is an improvement on the old system of having two officers independent of each other on the same station."

A good deal of excellent planting appears to have been done, but no statement showing the areas taken in hand is given.

A method of encouraging arboriculture frequently advocated in the Punjab appears to have been successful.

"Thus far I have referred only to the afforesting of Crown land. One of the chief functions of the Forest Department, however, is not only to form State Plantations on a large scale, but to assist and encourage by judicious means private individuals and public bodies to plant trees. It is the custom in America, India, and Australia. Notwithstanding much protestation from private seedsmen and gardeners, surplus plants and seeds of forest trees are yearly distributed throughout the Colony from this Forest Division.

"As a rule the cost price is charged, but in some cases they are given away gratis.

"On reference to Appendix C, it will be seen that from the Nurseries at Tokai and Worcester, no less than 107,969 young trees, valued at £338 5*s.* 9*d.*, were distributed, and Appendix D gives the quantity and kinds of seeds distributed from the store-room at Uitvlugt, and valued at £195 10*s* 5*d.*"

Sissu seedlings are distributed free to zamindars in the neighbourhood, from the Changa Manga Plantation near Lahore, and large numbers avail themselves of the privilege of taking these seedlings to plant in their fields.

The fourth annexure which, as we have stated, forms the bulk of the volume, is from the pen of Mr. D. E. Hutchins, Conservator of Forests, King William's Town. Mr. Hutchins devotes more space to examples of the inadequacy of the existing Cape forest laws and to proving the necessity for framing new ones than to reporting on the work done during the year. The report is, however, more interesting to the general reader than a mere description of the work, and it contains many interesting accounts of forest work at the Cape.

Mr. Hutchins' Indian experiences have shown him that the survey, settlement and adequate demarcation of the forests form the only sound basis of their management, and he urges this strongly throughout his report.

The Crown forests in the east of the Colony are classified naturally, he states, into MOUNTAIN FORESTS and COAST FORESTS.

"With the exception of the fine forest on the Amatola mountains and subsidiary ranges, the mountain forest in the East of the Colony has been either alienated, or rights of so destructive a nature have been granted, that the forest is rapidly disappearing. The Amatola forests, as a whole, still remain national property, an estate of which any country might be proud! Situated as these forests are, their destruction followed by the deterioration of the climate and water supply, would threaten the ruin of the surrounding country, and forest destruction there would probably be the determining element whether the country should progress and support its own increasing population, or relapse into the decayed condition of Bathurst and other earlier settled parts of the Colony. Grave and deplorable mistakes have occurred in the management of the Amatola forests in the past, as for instance when a large slice was nominally sold out of the centre of the Perie forest for *a small fraction of the value of the timber on it*, or when 50,000 immature young sneezewood saplings worth many pounds each, to the Stutterheim forests, were cut to make worthless sapwood telegraph poles. In the more accessible parts of the forests the best timber has been stolen, or sold for a trifle on time licenses. Happily a large portion of the forests was inaccessible without made roads, and this has been a great source of protection. Until the survey and final settlement of these forests, now in progress, is completed, it is difficult to say how far the mistakes of the past will affect the systematic working of the forests in the future. Much will depend on the manner in which their survey proceeds, and how the questions involved in their settlement are treated. A little firmness, a little liberality, now, in dealing with those, who, though they may have originally usurped forest rights have enjoyed them for many years, will put the Amatola forests on a sound basis of management.

"How a fine forest estate may be frittered away, and, as a whole, lost to the country, there is the sad history of the Katberg forest to tell. Plundered at first by wood-stealers, overworked and unsystematically worked by Government, for the sake of a few hundred pounds above the cost of management, thrice swept by fire; a few blackened and charred limbs standing in a tangle of thorns, now show where the forest once stood, a forest then the pride of the Province, and about which people who have not visited the locality for some years still speak with admiration. Localities such as these show little sign of natural reproduction, and left to themselves, are burnt over every second or third winter. Evergreen forest, if rationally managed, has nothing to fear from fire; but I have noticed, both here and in India, that if once destroyed its re-establishment is more difficult than is the case with deciduous forest, the species of which have fought out a struggle for existence in which fire plays the part of chief factor. The Katberg forest is said to have been originally superior to the finest virgin forest now existing on the Amatolas. What remains of the Katberg forests has been demarcated during the year;"

The term "working-plan" would appear to be used differently in the Cape to what it is in India and elsewhere.

"In the Amatola forests steady progress has been made on the

lines indicated in last year's report. The Dountsah, Isidenge and Perie forests have been surveyed and demarcated, the system followed being that which is in force in India. As the result of instructions from the Surveyor-General, *a good forest demarcation*, and a partial plan of the forest on the Hogsback, has been obtained from the Government Surveyor, employed in laying out agricultural allotments. This plan will now be completed by the Forest Department and adopted as the working plan of the forest."

It is evident that the survey, settlement and demarcation of the forests are being undertaken in a thoroughly business-like manner. But not before this was required.

"This has been the principal work on which my assistant and myself have been engaged throughout the year. It need hardly be remarked that before the systematic working of a forest can be introduced, the forest must have been surveyed. It must have clearly defined boundaries; and all forest rights and usages either extinguished, commuted, or clearly defined.

"On the topographical map of the Colony, a blank white spot shows roughly the position of the forest-clad Perie range of mountains; and along the main chain of the Amatolas some black, sketchy, and not very correct topography, occupies the place of the most important natural feature of the country, the forests. This deficiency is now in process of being supplied.

"The system of survey adopted is:—

"1*st*. A main system of triangulation with, as base line, Captain Bailey's recorded distance from his Hogsback Station to his Dohne Peak Station.

"2*nd*. A smaller triangulation furnishing points about a mile apart (or nearer where chaining is difficult), along the forest boundary and within the forest where points are required.

"3*rd*. Plane-tabling from point to point to fill up topographical and forest details.

"The first two months of the year were spent in completing the survey of the Hovàld and Dountsah forests on the main chain of the Amatolas. A much needed demarcation was thus completed between the forest and the native locations lying all along the base of the Amatola's from the Hogsback as far as the boundary of the Stutterheim Division. In the Stutterheim Division the country near the forest being settled with German immigrants, and the forest having already a tolerably clear boundary, the forest camp was shifted southwards and work commenced on the Perie Range, the most southerly portion of the Amatola forest country. Here the Isidenge forest was surveyed and demarcated; and then, the fog and rain of a wet autumn proving inimical to work on the mountains, the forest survey camp was moved below the Perie mountains and the demarcation and survey of the lower boundary of the Perie forest taken in hand. Demarcation was here very urgent. The natives of the Perie Mission Station had beacons within the forest. The position of these beacons was known only to a few, and no attempt had ever been made to cut lines through the forest and thus to demarcate the boundary between the forest belonging to Govern-

ment and that which was the property of the Perie Mission Station. Till this was done it was hopeless to attempt to conserve the Government forest. Naturally no Magistrate would convict where the boundaries were unknown, and numerous forest cases from this locality had failed in consequence. It was the work of several weeks to ascertain the exact position of the beacons within the forest and lay out the lines from beacon to beacon. To keep down the cost of cutting these lines, a staff line was laid out, and the line opened at first only sufficiently wide to chain along. These lines are now being opened to their full width of 15 feet, under the supervision of the Forester, on petty contract with the natives living near, the firewood being given free to those cutting the lines. Going east from the Perie Mission Station, the boundary of the forest passes several small farms. The present holders of these farms knew very little about the position of their beacons. Our experience here and elsewhere in demarcating the forest has been, that beacons of surveyed land touching Government forest have a general tendency to advance as the forest recedes; and sometimes they get lost in the forest. The necessity then arises for a partial re-survey of adjoining properties, in order to arrive at the forest boundary. The holders of these small farms bordering the Perie forest were too poor to reach by legal proceedings, even if it had been practicable to compel a re-survey of their farms. These re-surveys, therefore, so far as it was necessary to determine the forest boundary, had to be made by the Forest Department. From the small German farms the forest boundary was laid out across the front of Kwesha's location. Here an unchecked destruction of the forest had been going on for years. An instance of this was cited in last year's report. Budge's farm formerly touched the forest, but native mealie gardens have gradually crept in between his farm and the forest. There is little excuse for the forest destruction wrought by Kwesha's people; an ample area of arable land lies unploughed outside the forest, and there did not exist that semblance of a title for the destruction of the forest such as the Perie Mission Natives held. The greater portion of the mealie gardens stolen from the forest were, therefore, brought again within the forest boundary, and the Tyusha stream, a good natural feature, taken as the boundary between Kwesha's location and the Perie forest."

The subordinate establishment requires attentive consideration as regards housing. The employment of the guards as gardeners in addition to their other duties would not do in India.

"Four of the foresters are paid at the rate of £5 per mensem, two at £4 per mensem, and the native guards at £2 per mensem. The depressed state of the times permitted of an unusually favourable selection of men to fill these posts, and a good beginning has been made with serious forest work. The foresters, stationed at first in temporary huts in the forest, were occupied for some months building themselves cottages. Wood and grass was naturally supplied from the forest; ready-made doors and windows, a little roofing iron, and tools were sent out from King William's Town. Each forester was allowed one man as an assistant for three months.

The total cost of the five cottages completed has been £223 18*s.* 9*d.*

"The Quacu forester, appointed after the others, has had to postpone making his cottage for want of funds to buy the doors and windows, &c.

"As has been mentioned, each forester is stationed in the forest of which he has charge. He has the use of a cottage and five acres of irrigable land round his cottage to grow garden crops for his own use. Adjoining his cottage are two acres or more, of irrigable land devoted to a forest nursery. Each forester is expected to raise 40,000 young trees during the year, these trees to be partly exotic, and partly the more valuable of the indigenous species, growing in the forest of which he has charge. Exotic seed is supplied, indigenous seed is collected by the foresters."

The Conservator appears to have a firm belief in the utility of a plan for re-foresting blank areas which has been frequently tried and found to be a failure in India.

"The plan of employing forest cultivators, which was sketched out in the annual report of last year, has been carried into effect this year, so far with the best results. In the different forests 323 acres of ground have been brought under cultivation, with a view of preparing the ground for the reception of seeds and plants. About 170 acres in the Perie forest has been ploughed under a special agreement with Kwesha's natives. A small portion of the ground prepared has been already sown with yellowwood and pine seed, but almost the whole of it awaits the autumn rains and the acorn crop, which will now be ready in a few weeks. Only men likely to work are taken as forest cultivators. They are placed under the supervision of the nearest forester, and if they do not carry out their agreement and break up the ground as soon as rain falls, they are evicted. No permits are granted for longer than two years. Usually two years are granted for grass land, and one for clean land or burnt forest. The following is a copy of the form of permit used, and will sufficiently explain itself. In several cases during the year information leading to convictions for forest offences has been given by forest cultivators. The total number of forest cultivators is 66, who, with the exception of two Germans, are Kafirs or Hottentots. The average size of their allotments is a little under five acres (4·89 acres). The native system of cultivating with a Kafir pick, adapts itself admirably to the purpose of preparing land for planting on the mountain side."

The common English names of forest trees and woods in the Cape are peculiar, and a list of them reads rather like a list of stores in a Parsee general dealer's shop, in which the drugs and patent medicines had got mixed with the jams and bottled lollypops.

For instance, in the list of the trees Mr. Hutchins proposes to reserve from firewood cutting, we find such names as, red els, red pear, white pear, Kafir plum, boerbone, saffron-wood, essen-wood, wild olive, wild lemon, black-bark guarri, red currant, bitter almond, while stinkwood and sneezewood occupy deservedly prominent places in all lists of Cape woods.

As already stated, a large portion of the report is taken up with a discourse on the inadequacy of the present forest laws in the Cape. Mr. Hutchins certainly makes out his case, although a progress report is not, perhaps, the best place for the discussion.

"The want of a Forest Law more suitable to present circumstances of the Colony than the antiquated Act 18 of 1859, has been constantly felt. The 'Forest and Herbage Act,' short and incomplete as it is, was perhaps suited to a time when the belief was held that forest would grow and reproduce itself, like grass after a shower of rain; when no heed was given to systematic forestry, and when it was thought sufficient to protect certain kinds of trees, and to prevent incendiarism. But at the present day such an enactment is worse than useless. It becomes a stumbling block in the hands of a weak or inexperienced magistrate; since it deals with certain forest offences, and omits others equally harmful. Thus, setting fire to the forest is a punishable offence, goat-grazing, which is more likely to damage evergreen forest than fire, is not punishable. It may be replied that goats can be impounded, but the pound dues for goats are only one-sixth of those for cattle, and goats are infinitely more harmful. Horses are charged higher pound fees than cattle, while in a forest they do little or no harm. And pigs, which are beneficial in a forest, are charged six times the pound dues of goats. Therefore goat-grazing, as especially harmful to forests, requires special penalties in any Forest Act claiming to be complete. In many countries goats have played a more important part in the destruction of forests than any other agency. Again, cutting saplings of certain kinds of timber trees is a punishable offence, but the most valuable kind of timber trees escape the Forest and Herbage Act. To obtain a conviction under this Act for cutting timber saplings, it is necessary to prove that the sapling cut was of a kind of wood *ordinarily used for wagon-making, furniture, or building, in the year* 1859. Sneezewood is an excellent wagonwood, but too scarce to be used for this purpose in the Colony. Sneezewood is not ordinarily used for furniture, or house-building. And thus sneezewood, the most important species in the Eastern forests, can be cut with impunity, as far as the Forest and Herbage Act is concerned. Again firewood stealing is not punishable under the Act. Indeed, this unfortunate old Act actually pats the firewood stealer on the back: *vide* definition of term 'tree,' section viii. It is scarcely necessary to remark that if every one may go into a forest, and cut firewood and brushwood, when and where they like, there is an end at once to all forest management! Give a man a right to cut mature timber and his right can be regulated so as to do the forest no harm, but give a man the right to cut brushwood and small wood—the forest re-growth, and he obtains the forest outright! Within the last few weeks it has been decided that offences such as firewood stealing which cannot be reached by the old 'Forest and Herbage Act,' may be dealt with under common law. But this arrangement cannot be looked upon otherwise than as a makeshift, reversing as it does the legal maxim, that special enactments override common law. Again, under common law, punishment is awarded according to the value of the property stolen, which

no more meets the circumstances of forest cases, than if poaching or burglary were punished on the same principle Who would not poach if the punishment were twice the value of the game found in the poacher's possession? Yet the punishment on conviction for forest offences scarcely averages twice the value of the property stolen Forest property is similar to game, it is widely dispersed and difficult of protection It is as easy for a Kafir to slip into the forest, cut a sneezewood sapling, and sell it as a pole at the nearest canteen, as for a poacher to knock over a pheasant. Game cannot be protected without game laws, nor forest without forest laws Game has practically disappeared in France with the abolition of the game laws the forest would follow were the forest laws to be abolished. In other countries where forests have been conserved, special enactments dealing with forest offences, have been found necessary. Forest offences ought to be chargeable as such, and special penalties provided, which would bear some relation to the damage done to the forests, and to the inherent difficulty and expense of proving forest cases. In India, several Acts have been passed within the last 15 years. France, Germany, and other European countries have their forest codes The attempt to preserve the forests of Cape Colony without a Forest Act, must inevitably end in failure. People have not yet learnt how little there is to fear from forest prosecutions, or forest offences would be commoner than they now are. Occasionally an energetic magistrate deals out an adequate sentence, and the effect of this is magical. The wholesale stealing of sneezewood poles in Stutterheim came to an end, as the result of one forest case early in the year. But in the absence of a Forest Act sentences for forest offences can rarely be adequate. To instance, firewood stealing. A sharp man will probably steal several loads of firewood before he is caught Let us assume that on an average his third load lands him in a Court of Justice: his average punishment, if convicted, would now be about double the value of the wood stolen. And thus it pays this man better to steal firewood than to pay for it, under the present state of the law! Fortunately this is not generally known, and that even the light punishments awarded do have a deterrent effect, is shown by the fact that no person has been brought up twice during the year for forest offences. And I have the evidence of independent persons that firewood stealing at the present moment, is not the popular pursuit it was. Gradually, however, as the fact becomes known that there is no adequate punishment the offence will once more become common. To turn again to the profit and loss account of wood stealing; while this pays a man under the present law, the final loss to Government is large, even in the case of successful convictions. The small fine imposed may average two-thirds of the value of the wood stolen on this, and on previous occasions, but there remains the damage to the forest done by cutting all sorts of trees and by cutting in the wrong place, the expense of summoning witnesses (always from a distance in forest cases), the time of the Court, and the time of the forest officials spent in tracking the delinquents, hunting up evidence, going backwards and forwards to town to make affidavits and give evidence in the cases. To simplify this procedure the Conservator of Forests should have magisterial powers to deal with small offences, and that

his zeal may not outrun his discretion, it would be sufficient to provide for an appeal to the nearest magistrate. But perhaps where the want of a forest law is most acutely felt is in the fact that as the law now stands it is a matter rather of personal opinion, than of duty with a magistrate, whether he shall trouble himself at all about forest cases. On the one hand, there is the difficulty of knowing how to deal satisfactorily with forest cases under the obsolete Forest Act, and the doubt whether the evidence is good enough for trying the offence under common law; on the other hand personal opinions—are the forests worth preserving, is the attempt to do so being conducted in the right way, why not leave the forest to take care of itself? These and other questions must arise; and I submit that it is inconsistent, when the preservation of the forests has been determined upon, that there should be any difficulty, doubt, or personal bias, in dealing with forest cases.

"Forest offences should be charged before a magistrate under the proper section of a regular act, and not left a question of personal opinion. As an instance of the anomalies existing under the present state of the law, there is the curious fact, that on the frontier, the nearer a man is to the coast, the easier it is to steal firewood! At East London, firewood stealing is an honorable and lucrative profession, even when boxwood, worth one penny a cubic inch, is stolen and sold for firewood. At King William's Town the average of sentences has been light, and an active man working in the south of the Division, where there is a forester wanting, could perhaps make firewood stealing pay. At Stutterheim a firewood stealer would obtain a patient investigation of his case, but he would probably soon decide to seek the milder climate of the coast.

"There is another way in which forest cases suffer at present. If the magistrate refuses to entertain the case nothing more is heard of it. If on the other hand he tries and convicts, the case goes probably to the Eastern Districts Court for review, and may be quashed. A magistrate may be equally in error in refusing to take up a forest case, but of this the judges hear nothing. I would suggest that where a magistrate refuses to entertain a forest case, he should take the affidavit of the Forester or whoever reports the case, and add his reasons in writing for not taking it up. In important cases it is desirable that the Conservator should attend to prosecute, and in all cases, if only for the proper working of his department, the Conservator ought to have the opinion of magistrates on the cases brought before them. At present the Foresters report their cases to the Conservator, but when these cases fail he only hears the Forester's side of the question.

"A parallel has been drawn between private owners of forest and Government, and objection made that if private owners can do without special legislation why not those in charge of Government forest; but this parallel a moment's consideration will show, is illusory. When a private owner really preserves his forest, he fences it and warns off the public. This cannot be done with Government forests, both on account of their extent, and the fact that they are the property of the country, and exist for the use and enjoyment of all."

Foresters meet with difficulties and trials at the Cape as

elsewhere. The following story is well told, and is instructive as well as interesting—

"Mr. Atmore, the Chief Ranger in immediate charge of the Katberg forests, was occupied during the early part of the year in the special demarcation directed to be made, with the view of separating the conflicting rights of Government and of the erfholders in those forests. Early in the year I inspected the greater portion of this demarcation in company with Mr. Atmore. I found it had been well and carefully done. Everyone's interests had been considered, and at the same time a fair and quite manageable boundary had been obtained for the forest. The forest question in Stockenström had been so long a grievance, and the action of Government in protecting its undoubted rights had given rise to so much misunderstanding and bad blood, that when a final and satisfactory settlement seemed at last to have been affected, no pains were spared to render it complete and satisfactory to all parties. The Ranger attended meetings explaining the object with which the demarcation had been undertaken, discussed his line from point to point with those interested, and took as much interest in the work as if it had been the boundaries of his own farm that were being settled. He had to go into camp to complete the more distant portions of the demarcation, but all was finally finished by June. A Commission was proposed to hear objections and to definitely settle the line, but it was considered that its work would be little more than formal, the demarcation having been made so as to leave no real ground of complaint unconsidered. The opinion also had gained ground that any reasonable settlement was preferable to the endless disputes of a joint ownership of the forest. It should be mentioned that the demarcation line was laid out so as to reserve to Government the upper well timbered slopes of the mountains where the streams take their rise, and to make over to the erfholders, in absolute ownership, the lower scrubby forest known locally as 'Kreupelbosch.' A short delay was necessary for the nomination of the Commission, and then a series of 'Village Management Rules' was promulgated, upsetting at a stroke of the pen, all that had been done now and during a quarter of a century to preserve the forests, and transferring their management to recently constituted village boards. Experience has shown that the thrifty and industrious peasants of France cannot be trusted to manage their village forests. The temptation to realize is irresistible. We need not speculate on the effect of handing over the Crown forests of Stockenström to the Hottentot settlements of that Division dignified with the name of 'villages.' The locations, wholly or in part, have passed out of the hands of the original coloured proprietors to the white settlers, who have supplied them with drink and cheap luxuries. To expect that people who have been unable as a class to keep their own individual lands in their possession, could be entrusted with the communal ownership of such a tempting property as forests, is to indulge in a belief that every non-interested person knowing the locality would laugh at.

"It is my duty in writing the forest report of the year to record my protest against what has been done entirely without the know-

ledge of the Forest Department, and I do so in the hope that the mistake made may not prove irremediable. Should other means fail, I would suggest that the matter be brought specially to the notice of the Honorable the Commissioner of Crown Lands and Public Works, with a view to the passing of an Act for the restoration to the Colony of one of its few remaining forest estates. It has been suggested also that His Excellency the Governor might be prayed to rescind the Proclamation of the Village Management Rules as being illegal. I have the opinion of two Magistrates, experienced in forest law, that the alienation of any forest in the Colony is illegal; Act 14 of 1878, which regulates the disposal of waste land, reserving certain lands as public property, such as land near the sea, those lands containing valuable minerals, &c., makes an express reservation of forests. Section 15 of this Act reserves absolutely all forest and land known to contain valuable timber. Further, Section 12 of the same Act states that the assent of the Legislature is necessary even to dispose of bare land to public bodies. It seems, therefore, that the cession of the Katberg forests to the Stockenström erfholders is illegal in two ways:—1*st*, the assent of the legislature is necessary for such a gift to be legal, and this has not been obtained; 2*nd*, as alienating forest it is an illegal act *per se*. During the remainder of the year it has been the painful duty of the Ranger to look on at the plunder of the forest he has protected for so many years. Immediately the so-called Village Management Rules were promulgated, the erfholders naturally refused to have anything to do with demarcation, and they have since gradually awoke to the fact that they have been put in possession of a slice of public property—a property which in a few years will be irretrievably ruined, and which no after expenditure of public money can replace."

The financial results of forest management in the Cape are not very brilliant. At present the timber operations are on a very small scale. For King William's Town Circle, the revenue in 1884 only amounted to £1,019, and the expenditure to £2,799. Of the future financial prospects Mr. Hutchins writes as follows. It will be seen that Forest Officers at the Cape are strict protectionists.

"Owing to the slack demand for house-building wood, and the competition of imported deals, the market price of sawn yellowwood planking has been very low throughout the year. The average price of planking has not been more than from 10 to 12 shillings per one hundred running feet, or say little above one penny per running foot, or one shilling per sawn cubic foot. When it is considered that not many years ago large quantities of planking were sold at as much as £2 the 100 running feet in King William's Town, it will be recognized how prices have been forced down in recent years. Many of the old sawyers have gone over the Kei, where wood can be had at nominal prices on time licenses. Others remain here, working as forest cultivators in the summer, and as sawyers during the winter, an economical and satisfactory arrangement, which I hope, may long continue. But the low price to which Colonial

wood has sunk has almost ruined, not only the bushworkers, but every one connected with the home timber trade. The various saw mills, at King William's Town and in the country, are either closed, or working at a loss. Yellowwood planking is superior to American, especially for flooring; home-made joinery is better than American; but both the one and the other have been gradually undersold, especially since the port and railway at East London have come into existence. It is the history of a home industry almost ruined, by an unfair foreign competition; and the remedy would be admitted by the most old-fashioned free-trader, were he also a forester. The American competition is unfair, for the reason that the Americans are working their forests exhaustively and destructively, while our forests are being restored and worked within their yield. The reckless destruction of the forests in America, and the observed deterioration of climate which has followed in some of the drier States, has caused a widespread alarm. There are still, however, enormous stores of timber in both the States and Canada. Whether this comes to an end, in ten or twenty years, as some writers assert, or in half a century, does not much matter at present. Sooner or later the cheap wood from America will cease to arrive. We may indeed look forward to the day when our forests shall be equal to theirs in point of productiveness, and when the current of trade shall have set in our favour. But, in the meantime, the practical question before us is to obtain a fair revenue from our forests and protect the Colonial wood industries from extinction. If this unfair competition, between the small and exhausted forests of Cape Colony, and the vast forest resources of America is to last, there can be but one result. Even less than the interior drier States of America, can Cape Colony afford to sacrifice its forests. Happily, destructive working may now be said to be at an end here. The forests of Cape Colony are being put in order for scientific working, the fundamental principle of which is that *the cuttings shall not exceed the growth*. The American forests, on the other hand, are being worked destructively, and in a few years they must either be destroyed or worked systematically. And for the few years while this state of things lasts, our forests and wood trade must be protected from a ruinous and reckless competition, by an exceptional high duty on imported deals and joinery. Sweden, which supplies a portion of our imported wood, has cleared large areas of forest, but much also has been done to restore, and introduce systematic working in the forests. Writers on the forest resources of Sweden differ, and it is uncertain how long Sweden will be able to continue to export wood at the present low prices. The general opinion appears to be that the Swedish forests are being worked far above their yield. It is certain that considerable tracts of forests have been bought up by speculators and destroyed, to the ruin of the neighbouring farms in that rigorous climate. Both Sweden and America have facilities for working their forests such as do not exist here, and this constitutes a second reason why home timber cannot compete with imported timber at the present moment. The forests here have never possessed the bulk of material within a small area, nor the unrivalled water carriage, that exists in the pine forests of America and Sweden. But our forests will of course improve as

they are conserved and planted. And as systematic working extends, age-classes will develop, and then all the mature timber will be in one spot easily got at, and cheaply worked. And if water-carriage is wanting, it must not be forgotten that there is easy access from all the Eastern forests to the railway. The situation therefore is this: Colonial wood, which is now inaccessible and costly to work, will become gradually better and cheaper. Foreign wood will become dearer, with the exhaustion of, or introduction of, systematic working in the forests of America and Sweden. For some years to come, the revenue from Colonial forests must be supported, and the Colonial wood industries be protected by high duty on foreign wood. The only argument against such a course would be that it would make woodwork dearer than it now is. To this it may be replied that wood ought to be, and would naturally be dearer than it now is, but for the recklessness of our neighbours, and the geographical accident of a cheap sea-carriage to the two largest timber exporting countries in the world. Cape Colony with its few home industries, its dry climate and its precious mountain streams, its desert Karoo and beautiful forests, dare not do otherwise than protect its forests and forest industries. As a matter of pounds, shillings, and pence, it is surely sound economy to consent to dear wood for a few years now, in order to have cheap wood, growing in our midst, hereafter. The question of an increased duty on wood should be looked at from a forestal rather than a politico-economical point of view. It need hardly be pointed out that forest economy is a chapter containing much that is contradictory to the ordinary laws of political economy. The law of supply and demand for instance has only in some very exceptional cases produced forests. State ownership and management, the worst for most descriptions of property, are the best for forests. In this question of a greatly increased duty on foreign wood, the one object to be kept in view is to free our forests from the disastrous competition of forests worked destructively."

It is but just to say in concluding this notice, that we are indebted to Mr. Hutchins' report for whatever general idea we have formed of the state of forest organization and forest matters at the Cape. No information whatever can be gleaned from the, fortunately, brief remarks of the Superintendent of Woods and Forests, and the compilation his remarks introduce is alone rendered readable by the extremely interesting, if somewhat rambling, observations made by the Conservator of Forests, King William's Town.

BOTANICAL RESULTS OF THE "CHALLENGER" EXPEDITION.

Mr. Hemsley's report on the Botanical results of the "Challenger" Expedition, which is reviewed at length in "Nature" (February 11th), is full of interesting data regarding insular floras, and we give the following extracts from the review for the benefit of our readers :—

"Islands may be arranged, he says, for phytogeographic purposes, in three categories, according to their endemic element, namely:—(1), Those with 'vegetation comprising a large endemic element, the nearest affinities of which are not always found in any one continent;' to this category belong St. Helena, Juan Fernandez, the Sandwich, Galapagos, and Seychelles Groups. (2), Those with 'vegetation comprising a small, chiefly specific endemic element, the origin of which is easily traced;' here are included the Bermudas, Azores, Ascension, the islands in the southern part of the Indian Ocean, and the Admiralty Islands. (3), Those with a 'vegetation comprising no endemic element' (which have become stocked with plants in very recent times); such are the Keeling and other coral islands in the Indian and Pacific Oceans. A statistical account of floras of several islands not treated of in detail in the subsequent reports is given to illustrate the feature characteristic of these several categories.

"A very prominent place is given by Mr. Hemsley to the question of the 'dispersal of plants by oceanic currents and by birds' In the appendix to Part III. there are descriptions of drift-seeds and seeds-vessels, and of seeds and fruits from the crops of birds, collected by Mr. Moseley, Dr. Guppy, and others, to which is prefaced an historical *résumé* of the subject. We have in fact an epitome of all that has been written upon the subject up to the present time. The evidence Mr. Hemsley brings forward of the potency of these agencies in plant-dispersion is irresistible, and effectively overthrows the opinion so frequently expressed by Alphonse de Candolle—an opinion founded in great part upon the capacity of seeds to retain vitality when immersed in sea-water, as determined by experiment—that oceanic currents have played and play an unimportant part in plant-diffusion. The views of the two botanists are placed in striking contrast by a comparison of the list of species certainly or probably dispersed by ocean currents given by each: De Candolle's contains about two dozen, Hemsley's over 100. Mr. Hemsley guards himself against being supposed to regard the sea as the principal agent, or indeed as anything more than a subordinate agent in bringing about the present distribution of plants, 'for it is manifest that the action of currents and birds of passage are insufficient to account for certain elements in the vegetation of many islands.' But at the same time he goes so far as to maintain that the littoral flora owes its present characteristics to the fact that the seeds of the plants composing it are capable of withstanding long immersion in sea water, and are thus suited for oceanic transport. That the present general diffusion of a large proportion of the plants inhabiting the tidal forests and sandy and muddy sea-shores of the tropics is in a great measure due to oceanic currents is, in his opinion, quite certain from the evidence; a view from which few, we imagine, will be inclined to dissent. In illustration of this subject he gives (taking a small selection of flowering-plants whose seeds are transported by oceanic currents and by birds) the following picture of the gradual invasion of an island by herbs, shrubs, and trees. 'The seeds of many almost ubiquitous sand-binding grasses may be reckoned among those which are cast ashore in a vital condition, and we assume that these grasses are amongst the first flowering-plants to obtain a foot-

ing. Other herbaceous plants met with in the earliest stage of such an insular flora are *Portulaca*, *Sesuvium*, *Canavalia obtusifolia* and *Ipomœa biloba* (*I. pes-caprœ*): all of which seem to possess an unlimited power of colonisation. Moreover they provide the conditions necessary for other plants to be able to establish themselves. Among the early shrubby occupants, *Suriana maritima*, *Pemphis acidula*, *Scævola Kœnigii*, and *Tournefortia argentea* are prominent, being found on the most remote islets of the Pacific and Indian Oceans within the tropical and sub-tropical zones. Where there are muddy shores, there the various mangroves (*Rhizophora*, *Bruguiera*, *Avicennia*, *Vitex*, &c.) take possession. Among the first real trees are *Heritiera littoralis*, *Hibiscus tiliaceus*, and *Barringtonia speciosa*, together with screw-pines. After this nucleus of a flora has been formed, it is comparatively easy for other arrivals to establish themselves; and every addition in a measure helps to provide the conditions for a still more varied vegetation.' And he concludes:—'It may be safely assumed, therefore, that if oceanic currents and birds have not been the means of dispersing a large number of species of plants, and it is not certain that they have not, they are certainly the most important agents in stocking islands, for without their action the numerous remote coral islands, at least, would still be utterly devoid of phanerogamic vegetation, and consequently uninhabitable.'

As a concrete illustration of the influence of these agencies in stocking islands, an analysis of the indigenous vegetation of the Bermudas is given, which shows that 45 species are chiefly littoral plants, the seeds having been probably conveyed to the island by oceanic currents; 38 are marsh plants, with small seeds, possibly conveyed to the island in mud adhering to birds, though many may have reached in vegetable drift; 13 are plants with more or less fleshy fruits, and probably were carried by frugivorous birds, leaving a very small number of species introduced, probably indirectly, by man.

"Mr. Hemsley points out that the absence of general structural peculiarities in insular plants, and the occurrence of their physiognomic features in many continental areas, adds to the difficulties of plant geographers. He shows that no order, no sub-order, not even a tribe, is endemic in the smaller oceanic islands, and that the very distinct genera that occur are not disproportionate. To the question, Do the flowers of endemic insular plants present any peculiarities of size, shape, or colour? we get an instructive answer in the tabulated analysis of the endemic plants of St. Helena. From it we learn that 'the size of the flowers and flower-heads in this flora is on the whole rather above than below the average of those of their allies in other parts of the world. When we come to colour, however, the equality fails altogether, red being almost entirely wanting in the insular plants, and blue unknown.' The absence of butterflies and the abundance of moths on the island is a significant concomitant circumstance, as Mr. Hemsley remarks. Particulars are not yet forthcoming from other islands to permit of like analysis, and Mr. Hemsley merely concludes that brilliantly-coloured flowers are rare in such islands.

"Amongst the special features of insular floras discussed and illus-

trated by Mr. Hemsley in the introductory portion of the volume, is the preponderance of shrubby and arboreous *Compositæ*, and of woody plants generally. That islands 'often possess trees and bushes belonging to orders which elsewhere include only herbaceous species' as Darwin stated, he shows, by tabulated evidence of the occurrence of arboreous or shrubby forms allied to insular ones upon continental areas, requires modification. To illustrate the difficult problem of the absence or rarity of large, almost ubiquitous, orders in oceanic islands, he selects *Leguminosæ*, *Orchideæ* (the table showing the absence of species or the number of species of *Orchideæ* in various islands is extremely interesting), and *Gymnospermæ*; and the concomitant rarity of insects is suggested as a probable explanation so far as the first two orders are concerned."—*Nature*.

ILLUSTRATIONS OF THE INDIGENOUS FODDER GRASSES OF THE PLAINS OF NORTH-WESTERN INDIA.*

THIS excellently got up volume, which is published at the very moderate price of Rs. 5, meets a long felt want. The forests of the sub-Himalayan tract abound with many species of grass, and now that the fodder supply for Commissariat cattle and for the horses of Cavalry Regiments and Artillery is inadequately met from the cultivated country round the cantonments, it is very important that Forest officers should be able to identify the different species of grasses in their forests, and to be acquainted with their qualities.

The plates in the volume before us are excellent nature-printed impressions, executed by Mr. T. D. Bona, Superintendent of the Thomason College Press, Roorkee, and are accompanied in most cases by enlarged anatomical diagrams of the flowering organs.

A descriptive letterpress is promised by Mr. Duthie for next cold season, and will be very welcome.

* Edited by J. F. Duthie, Superintendent, Government Botanical Gardens, Saharanpur. Nature-printed at the Thomason Civil Engineering College Press, 1886.

III. Notes, Queries and Extracts.

BIRD-MURDER.—A very urgent appeal to the public has just been issued in America by our contemporary *Science*, which journal has attached to its issue of February 26 a special "Supplement" devoted to the question of "the present wholesale destruction of bird-life in the United States." Powerful articles have been written by Messrs. J. A. Allen, W. Dutcher, and G. B. Sennett, three prominent American ornithologists, in which the facts have been plainly set forward, remedial legislation proposed, ending with an "appeal to the women of the country on behalf of the birds."

The American Ornithologists' Union has also appointed a "Committee on Bird-Protection," and from the names of the gentlemen who are serving on it, it is quite certain that practical remedies will be forced on the consideration of the American people, and that energetic efforts will be made to preserve the birds from destruction. But it is equally certain that a corresponding effort must be made by civilised nations on this side of the water, if remedial measures are to have a real effect, and we are glad to find that steps are being taken to attract public attention to the gross scandal which now exists in our midst. A "Selborne Society" has been formed, of which Mr. G. A. Musgrave, of 45, Holland Park, is the secretary, and of which H. R. H. Princess Christian is a patron, for the protection of birds. Invoking the shade of the gentle Gilbert White of Selborne, this Society may hope to prevail somewhat with the English nation; which would undoubtedly protest with the same vehemence on behalf of the small songsters of England, as it did some years ago on behalf of the sea-birds, if the facts are but put plainly forward. We are certain that if the women of this country only knew the real state of the case, the senseless and savage decorations now in vogue would be regarded with disgust and loathing. The Selborne Society has but just commenced its labours, but already many excellent well-wishers have joined it, and it numbers amongst its members many names famous in society, in art, in literature, and in science.

There is scarcely a portion of the world which is not being devastated of its birds at the present moment to minister to the fashionable wants of the women of Europe and America, and it is as well that the root of the evil should be recognised at once. This has been done in America, and the point must be insisted

on again and again in this country, that the vanity of womankind is in this enlightened age the cause of the "wholesale destruction of bird-life" on this side of the Atlantic as much as in America. Nor is it confined to the higher classes. The difference between the factory-girl and the high-born lady as regards the question of bird-feather decoration is only one of degree, the former paying as many halfpence for the starling's wing in its natural state as the latter does in shillings for the same article dyed or gilt out of recognition as it may be. New Guinea and the Papuan Islands are being despoiled of the birds of paradise, India and Africa of their sun-birds and rollers, Southern Europe of its bee-eaters, until every one of these countries is being exhausted of its feathered denizens. It is no longer the brightly-plumaged species which are being laid under contribution, for, as exhaustion has begun to limit the supply, the soberly-clad birds are now being shot down in thousands to minister to "fashion" in this country. Thus any one with a knowledge of birds has only to walk down any fashionable thoroughfare in London, and note the materials with which the bulk of the hats in the milliners' shops are decorated, to see that robins, sparrows, larks, and starlings are a staple commodity with the trade in this country. Dyed they are in most cases, and occasionally relieved by the wings of some Indian "jay" (*i. e.*, roller), or African "merle" (glossy starling) or sun-bird, or it may be with a few "osprey" feathers. These last are the long breeding-plumes of the egrets, which are developed only during the nesting season, and the slaughter amongst these birds at that time of the year must be something incredible. No wonder that Mr. Allen complains that the "swamps and marshes of Florida have been depopulated of their egrets and herons." It is not as if the birds thus slaughtered were harmful, the killing of them beneficial. On the contrary, the majority of the species now massacred are distinctly beneficial to the countries they inhabit, and surely no one could wish that this country should be deprived of its birds and reduced to the generally unaviferous aspect of France and Italy.

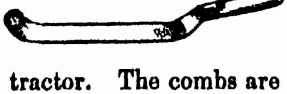
It is said that legislation in the direction of the further protection of birds would be an interference with the legitimate industry of the "plume" trade. This is by no means the case. There are many birds which are used as articles of food, the plumage of which could be utilised for decorative purposes; and that this is well known by the trade is evidenced by the large number of dyed fowls' wings which figure largely in the composition of hat and bonnet ornament. Just as before, when the outcry against the slaughter of gulls and sea-birds rendered the wearing of their feathers unfashionable, the milliners adapted their wares to the wants of their customers, so would they once more find substitutes for the larks, robins, and other small birds which they now use by the thousand.

Our American brethren have put forward some practical suggestions with regard to a stoppage of the traffic. Mr. Allen shows that in the natural order of things birds have already sufficient enemies to contend against without having the hand of man turned against them too. Vast numbers perish in the eggs, which are the food of many predatory animals, and numbers perish while yet too young to defend themselves against their enemies. To stress of weather also and the trials of migration large quantities of birds succumb, and a severe winter like the last one causes the death of birds of all classes alike. On the top of all these ills which ornithological flesh is heir to, comes a blood-thirsty demand from the women of civilised nations for their small bodies to adorn hats or ball-dresses—in order that our belles may not leave the monopoly of feather ornamentation to savages. Statistics have not been published giving an exact account of the number of birds annually sold in London by auction for the plume trade, but it is well known that the numbers are enormous. Thirty thousand ruby-and-topaz humming-birds are said to have been sold some years ago in the course of an afternoon, and the number of West Indian and Brazilian birds sold by one auction-room in London during the four months ending April 1885, was 404,464, besides 356,389 Indian birds, without counting thousands of Impeyan pheasants, birds of paradise, &c. In Mr. Dutcher's article on the "Destruction of Birds for Millinery Purposes," he quotes from an article in *Forest and Stream*, wherein one dealer, during a three months' trip to South Carolina, prepared no less than 11,000 skins. "A considerable number of the birds were, of course, too much mutilated for preparation, so that the total number of the slain would be much greater than the number given. The person referred to states that he handles, on an average, 30,000 skins per annum, of which the greater part are cut up for millinery purposes." During four months 70,000 birds were supplied to New York dealers from a single village on Long Island, and an enterprising woman from New York contracted with a Paris millinery firm to deliver during this summer 40,000 or more skins of birds at 40 cents apiece. From Cape Cod, one of the haunts of the terns and gulls, 40,000 of the former birds were killed in a single season, so that "at points where, a few years since, these beautiful birds filled the air with their graceful forms and snowy plumage, only a few pairs now remain." The above extracts out of many interesting facts which could be quoted from the articles in *Science*, give some idea of the slaughter which is going on at the present time, and it is to be hoped that some *immediate* steps may be taken to call public attention to this wholesale bird-murder, before the nesting season begins, when most of the mischief is done among the sea-birds which congregate in large numbers at that time of year.

Space does not permit us to traverse the whole of the ground taken up by our contemporary, whose articles occupy fifteen pages, but we trust that they will be perused by our readers for themselves. Mr. Sennett's essay on the "Destruction of the Eggs of Birds for Food" proves the wanton waste which accompanies the ways of the professional "egger," to say nothing of the cruelty which accompanies the taking of the eggs. The "Relation of Birds to Agriculture" is a well-written article, as is also an essay on "Bird-Laws," the latter containing resolutions which, if adopted by the Legislature, would undoubtedly prove of great service in protecting bird-life on both sides of the water, but no legislation will avail unless the women of America and Europe can be made to understand that they are absolutely responsible for the wholesale destruction of birds which is now going on, to the great benefit of the plume trade and the milliners, but to the everlasting detriment of the world on which we live. We should like to see some authorised body, such as the British Ornithologists' Union, the Selborne Society, or a Committee of the British Association, taking this matter in hand and organising public meetings to bring the true facts of bird-slaughter before the public; and we have every faith in the good sense of English women to secure a stoppage of the trade which exists by their patronage alone, and which is thoroughly antagonistic to the instincts of humanity.—R. Bowdler Sharpe.—*Nature.*

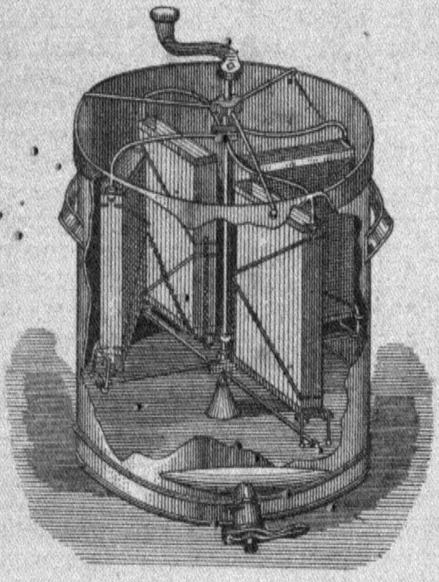
Extracting Honey.—Since the invention of the Movable Comb Hive, there has been none made so valuable to bee-keepers, as the machine for throwing honey from the combs by centrifugal force, called the "Honey Extractor." This was invented about the year 1868, by Herr Hurschka, of Germany. It consists of a tin can, inside of which is a central upright shaft, which is made to revolve with great rapidity by means of a crank and gearing. The shaft carries a reel, or a set of comb baskets to hold the comb while it is being extracted. When the combs are filled with honey, they are to be taken from the hives, and the adhering bees shaken and brushed from them. With a knife made for the purpose (*Fig.* 1), the cappings of the cells are shaved off, and the combs placed in the comb baskets within the extractor. The combs are then revolved rapidly enough to throw the honey from the cells. After the cells upon one side of the comb are emptied, the motion of the machine is reversed. The comb baskets are so arranged that they will reverse also, and allow the other side of the comb to be emptied. A faucet or molasses gate, is arranged at the bottom of the can, to draw out the honey as it accumulates. After the combs are emptied, they

Fig. 1.—HONEY KNIFE.



are returned to the hives to be refilled by the bees. Since the original honey extractor, numerous improvements have been made in its construction, and there are now several different kinds offered to bee-keepers. The extractor illustrated in *Fig.* 2, is known as the "Stanley," which presents many manifest improvements, especially that which allows the combs to be reversed within the can. Previously it had been necessary to take

Fig. 2.—CENTRIFUGAL HONEY EXTRACTOR.



the combs out of the can, and turn them, in order to empty the cells on the opposite side.

I have combs now in use, and in perfect condition, which have been emptied several times each season for fifteen consecutive years. Before the invention of the honey extractor, liquid or strained honey was secured by crushing the combs and straining the honey through a thin cloth. In this way it contained pollen and other impurities, and the bee-keeper likewise sustained great loss in the destruction of the combs. With the use of the extractor, the honey only is removed, free from all impurities, and the combs are uninjured. Partly filled sections, and pieces of white comb, may have the honey taken from them, and then be laid away for another season's use.

Another very important advantage in the use of the extractor, is that each quality of honey may be secured separately. As soon as the yield of honey from any particular honey-producing plant is over, the combs may be entirely emptied, and be ready to receive the honey from flowers that bloom next in

succession. In this way, light and dark grades of honey may be kept unmixed.—*American Agriculturist.*

TROPICAL DEW.—Having had occasion to lay out a large quantity of iron hoes and picks, without handles, on the hard ground of an open inclosure in one of the driest districts in India (Bellary), where in fact these implements had been collected in the face of a scarcity, it was found, after they had lain a couple of months, that a thick, weedy, but luxuriant vegetation had sprung up, enough, though there had been no rain, to almost hide the tools. The effect depositing tools on grass has had in stimulating its growing the writer has observed in the tropics before, but was at a loss to account for it, except upon some irrecolvable theory of radiation of magnetism.

The whole phenomenon is cleared up by Mr. Aitken's paper on "Dew" in "Nature" of January 14 (page 256), dew being proved deposited, not, as generally thought, from the air above, but rising and condensing from the soil below; and the ground in India is always hygroscopic. The outer surfaces of the iron tools radiate of course quickly at night, and the stratum of air inclosed between the metal under surfaces and the earth is, therefore, saturated with condensing moisture. That iron gratings laid on bare ground will raise a rank vegetation in places with only 10 or 15 inches of annual rain fall, and exposed to tropical heat, is a not unimportant fact, as being a readily available substitute for irrigation water, worth further investigation.—*Nature.*

MR. E. W. D. HOOPER, of the Madras Forest Department, is at present on a visit to Jamaica, having been deputed by the Secretary of State to inquire into the effects of deforestation in the West Indian Colonies.

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FOREST ORGANIZATION FOR BEGINNERS.

(Continued from page 298).

SECTION IV.—*(continued).*

CHAPTER VI.—*continued.*

2. METHOD OF PERIODIC AREAS.

By massing together several annual coupes in the example, ust given, of the method of equal annual areas, we have in a neasure anticipated the description of this system, although the eader was warned that each periodic area was to be imagined split up into ten annual coupes. The difference between the two is indeed not very great. By the method of equal periodic areas, the annual coupes during a period (usually 10—30; at most 40) are taken together and called collectively a *periodic area.* These periodic areas, or *affectations.* as they are sometimes called, are designated first, second, third, according as they belong to the first, second, or third period of the revolution, and so on. Supposing that a forest of 1,200 acres, is subjected to a revolution of 120 years with periods of 20 years (which is the term generally chosen for seedling-forest), there would then be

$$\text{an annual coupe of } \frac{1200}{120} = 10 \text{ acres, and}$$

$$\text{periodic areas of } 10 \times 20 = 200 \text{ acres each.}$$

There would be six such periodic areas, and, if the age-classes were complete, the first would comprise all trees 101—120 years old, in equal proportions; the second, all 81—100; and so on down to the last stocked with trees 1—20 years old.

There are two forms of this method. According to the older one, each compartment of the series is allotted to a certain periodic area, and is shown on the map as belonging to one particular affectation. In the diagram, at page 339, for instance, which represents a forest of 540 acres, divided into two blocks, each containing three compartments, if the revolution of

the series be 90 years, each compartment should, according to this form of the method, be devoted to one particular affectation, and may consist of, say, 30 annual coupes. Supposing that the stormy quarter is on the left-hand, compartments 1, 2 and 3, in one block, and 6, 5, and 4 in the other, may be respectively allotted to the first, second, and third affectations. Or, number 2 might be allotted to the first, number 3 to the second, and number 1 to the third; or, again, number 3 might be put first, number 1 second, and number 2 third; the disposition depending on which is the most suitable arrangement in order that the groups may be exploited most advantageously. Similar alternative dispositions might be made in the other block.

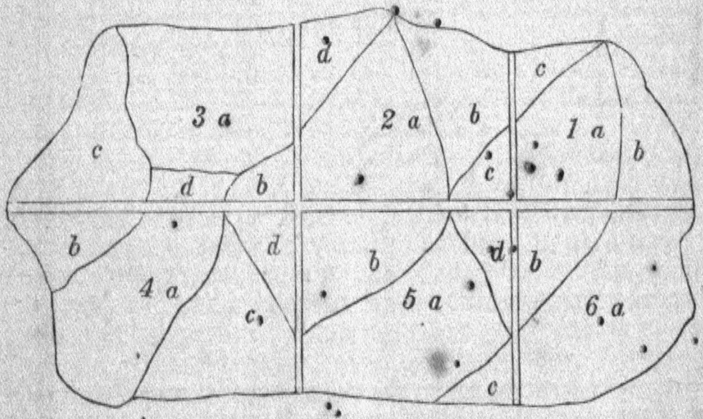
By the more modern system, a compartment is not necessarily allotted wholly to one particular affectation, but may be split up into portions belonging to different periodic areas. At the present day, there is very little real difference between these two forms, because the most enthusiastic advocate of a good sequence of cuttings would never now dream of confining the coupes during a period to one particular compartment of a block unless the age-classes harmonised fairly well with such an arrangement; but, at one period of the history of organization, great sacrifices used to be made to effect a good sequence, very young groups being often cut away, and old ones left standing long beyond their proper term, in order to attain this object. Now-a-days, therefore, the marking-off of affectations on the map, or in the forest, in series in which the age-classes are very irregular, has lost all meaning, and could at most serve to emphasize the state which it is desired to bring about sooner or later; in other respects, however, it is worse than useless in such cases, as it does not show the actual periodic areas, which may be scattered about all over the series, as is the case in the example which follows. A plan of exploitation for very irregular forest is generally considered satisfactory if it enables the manager to cut, in each period, the groups most suitable for exploitation during such period, without detriment or danger to those left standing.

Apart from the considerations already noted, it seems to be quite possible to carry the mania for establishing a whole series of coupes, one behind the other, to excess, as, for instance—to take an extreme case—when a large forest is exploited by means of only one coupe yearly, and the coupes proceed in regular order, one behind the other, the forest rising up, step-like, from the one-year-old to the oldest group. In such a case, the good old rule, that a coupe adjoining an old one should not be made until the young growth on that immediately behind it is established, could not be applied. And, if fire got into a long row of coniferous thickets, what a blaze there would be! Whereas, when the sequence of young groups is broken by older groups, fire is much more easily arrested. Again, when forests have been seriously attacked by insects, interrupted age-classes have often been found very useful in arresting the spread of the evil.

Very great regularity over a large area may, therefore, often turn out to be a serious obstacle to good management. The alternative is, numerous comparatively-small blocks, in which cuttings can be easily regulated so as to meet the exigencies of sylviculture as well as of good sequences. The numerous advantages derivable from small blocks must at once be apparent to everyone. Take, for instance, the case of a plantation attacked by the beetle *Hylobius abietis*: cuttings might be immediately stopped in the block attacked and not resumed until the beetle had disappeared. Or, take the case of a failure of young seedlings in a group to be naturally regenerated, or in a young plantation; further cuttings in the sequence of the block could be easily postponed, if necessary, until regeneration had been effected on the area of failure. But, in a forest consisting of one large block—to take an extreme case—interruptions to the sequence might not be feasible: at least, the drawbacks to breaking the sequence might outweigh any possible advantages of resorting to it, as, for instance, when suitable intermediate cuttings could not be effected without exposing old groups to dangerous winds.

Example of the determination of the yield by the method of periodic areas.

The accompanying diagram represents a seedling-forest of 540 acres, subject to a revolution of 60 years with periods of 20 years each, and stocked with the following groups:—



1*a*	of	30	acres,	group	80 years old.
b	,,	20	,,	,,	21 ,,
c	,,	12	,,	,,	15 ,,
2*a*	,,	45	,,	,,	30 ,,
b	,,	31	,,	,,	15 ,,
c	,,	10	,,	,,	80 ,,
d	,,	15	,,	,,	65 ,,
3*a*	,,	56	,,	,,	65 ,,

3*b*	of	8	acres,	group	30 years old.
c	„	37	„	„	5 „
d	„	7	„	„	45 „
4*a*	„	43	„	„	45 „
b	„	14	„	„	55 „
c	„	33	„	„	10 „
d	„	14	„	„	30 „
5*a*	„	55	„	„	10 „
b	„	30	„	„	30 „
c	„	11	„	„	blank
d	„	13	„	„	5 „
6*a*	„	42	„	„	21 „
b	„	14	„	„	80 „
		540			

For the sake of shortness, the revolution is taken as 60 years only. For the same reason, the compartments are assumed to be fully stocked and of uniform fertility, yielding the following returns per acre.

Age of group.	Yield per acre, cubic yards.	Age of group.	Yield per acre, cubic yards.
5	1	60	276
10	3	65	300
15	19	70	322
20	37	75	343
25	60	80	364
30	96	85	385
35	120	90	404
40	158	95	422
45	204	100	441
50	225	105	457
55	252	110	460

The object desired is to combine the cutting of the most mature groups first, and the establishment of sequences in each block, so that numbers 1 and 6 shall be exploited in their respective blocks before numbers 2 and 5, and the latter before 3 and 4: further, it is desirable so to organize the cuttings that those in each compartment shall proceed in regular order from right to left. In such irregular forest, all these objects can not be attained, so that if a regular sequence is to be effected, some groups must evidently be exploited before, and some after, maturity. For groups thus situated, the question may be whether it is, on the whole, advisable to sacrifice an immature, but still marketable, group—there can be no doubt as to the proper course to pursue in regard to groups which are not marketable—and thus secure a good sequence, or if it is preferable to leave it standing until the proper term has been reached, or until the

cuttings naturally again come round to the same spot, thereby postponing indefinitely the establishment of a regular sequence. Or, it may be a question of holding-over a mature group until the sequence reaches it in due course.

Questions of sylviculture, of immediate or prospective yield, of increment and general growth, and many other considerations, may sometimes incline the balance in favour of exploitation, sometimes in favour of retention; but as the decision depends entirely on arbitrary judgment, various schemes are evidently practicable, all perhaps equally justifiable and good, of which the following is one.

The area of the series being 540 acres and the revolution 60 years, the annual coupe is $540 \div 60 = 9$ acres; and, a period being of 20 years' duration, each affectation is $9 \times 20 = 180$ acres in extent.

1st Affectation.

Sub-compartment.	Present age of group.	Age at time of exploitation.	Area, acres.	Yield, cubic yards.	Remarks.
1*a*, ...	80	90	30	12,120	
2*c*, ...	80	90	10	4,040	
6*b*, ...	80	90	14	5,656	
2*d*, ...	65	75	15	5,145	
3*a*, ...	65	75	56	19,208	
4*a*, ...	45	55	43	10,836	
4*b* (part), ...	55	65	12	3,600	
Total, ...	...	...	180	60,605	

2nd Affectation.

Sub-compartment.	Present age of group.	Age at time of cutting.	Area, acres.	Yield, cubic yards.	Remarks.
3*c* (part), ...	5	35	2	240	Safety-cutting along border of 3*a*.
4*b* (remainder),	55	85	2	770	
3*d*, ...	45	75	7	2,401	
1*c*, ...	15	45	12	2,448	
2*a*, ...	30	60	45	12,420	
5*b*, ...	30	60	30	8,280	
4*d*, ...	30	60	14	3,864	
3*b*, ...	30	60	8	2,208	
1*b*, ...	21	51	20	4,684	
2*b*, ...	15	45	31	6,324	
6*a* (part), ...	21	51	9	2,063	
Total, ...	...	...	180	45,602	

3rd Affectation.

Sub-compartment.	Present age of group	Age at time of cutting.	Area, acres	Yield, cubic yards.	Remarks.
6*a* (remainder),	21	71	33	10,771	
3*c* (remainder),	5	55	35	8,820	
5*c*, ...	0	50	11	2,475	
6*b*, ...	80	40	14	2,212	Second time during the revolution.
5*d*, ...	5	55	13	3,276	
5*a*, ...	10	60	55	15,180	
4*c* (part), ...	10	60	19	5,244	
Total, ...	...	...	180	47,978	

It is assumed that the blank in 5*c* is afforested at the beginning of the revolution.

Safety-cuttings consist in clearings 30, or more, feet broad, made on the weather-side of a group when it is young, to enable it to withstand, when older, the sudden exposure caused by the cutting of the group immediately in front of it. If the area cleared is not re-stocked, the additional light and space causes the trees on the margin to develope stronger roots and lower branches, and so to resist the storm and afford a protecting shelter to the trees behind. If the area is re-stocked, the young group forms an effective wind-break. The safety-cutting in the second period is necessary to protect the group in 3*a* when the trees in 3*c* are cut during the third period.

The average age of a group of the first period is found by adding to its present age 10 years (half a period); that of a group of the second period by adding 30 years; and that of one of the third period by adding 50 years. In this manner the average age of exploitation is obtained with sufficient accuracy, as it is impossible to foresee the exact year in which a group will be cut. At the same time, by a little management, groups put down for cutting before their proper term can often be kept till nearly the end of the period, so as to give them a few years additional growth; and over-mature groups may often be exploited at the beginning of the period. By cutting 6*b*, for example, at the very commencement of the first period—which is quite feasible and desirable, too, for several reasons—and by keeping the fresh crop standing until the very end of the revolution—which would be quite practicable if the proposed order of cuttings were not disturbed by unforeseen occurrences—the fresh growth would have attained an age of 55 or more before being cut, instead of 40.

At the end of the revolution, even if everything went on without a hitch, the age-classes and sequences would be far from perfect; but by the end of the second revolution regular age-classes and a good sequence of cuttings might be established in the following manner without much loss, supposing that nothing occurred to alter the plan :—

1st Affectation.

Sub-compartment.	Area.	Age of group.
1*a*,	30	60
3*b*,	30	40
4*d*,	14	40
4*c* (part),	7	80
4*a*,	43	60
4*b* (part),	12	60
b (part),	2	40
1*b*,	20	40
1*c*,	12	40
2*c*,	10	60
Total, ...	180	

2nd Affectation.

Sub-compartment.	Area.	Age of group.
2*b*,	31	60
2*a*,	45	60
2*d*,	15	80
3*a*,	56	80
3*b*,	8	60
3*d*,	7	60
3*c* (part),	2	60
3*c* (part),	16	40
Total. ...	180	

3rd Affectation.

Sub-compartment.	Area.	Age of group.
3*c*,	19	60
6*a*,	42	60
6*b*,	14	60
5*c*,	11	60
5*d*,	13	60
5*a*,	55	60
5*b*,	26	40
Total, ...	180	

This method is preferable to that of equal annual areas, because it allows the executive to choose, within certain necessary limits, which groups shall be exploited from year to year, thereby affording full scope for the exercise of the manager's judgment in selecting groups for regeneration. In other respects, as regards seedling-forests, it would appear to have all the disadvantages of the older system, notably that, since the annual yield is regulated solely by area, great fluctuations may occur from year to year, more particularly in irregular forests and those subject to long revolutions, thus perhaps upsetting the

market for the produce, and causing inconvenience and loss to the proprietor and the public. It is evidently inapplicable to natural regeneration by seed, which can not be effected by making a clean sweep of the trees on the annual coupe.

3. Hartig's Method.

In order to avoid some of the inconveniences arising from the methods of area when applied to seedling-forests, Hartig struck out quite a new line. He discarded altogether the area of the forest as regulator of the yield, basing his calculations on the estimated contents and increment of the whole forest. His method consists in estimating the contents and increment of the whole forest, dividing the revolution into periods, and so arranging the cuttings that the same quantity of estimated material shall be cut in each period, and the whole forest cut over during one revolution. The method is very simple, and will be easily understood by means of the following example:—

Example of Hartig's Method.

We will take, for this purpose, the forest of 540 acres described at page 339. As in the last example, the revolution is 60 years with three periods of 20 years each, and the following yields:—

Age of group.	Yield per acre.	Age of group.	Yield per acre.
Years.	Cubic yards.	Years.	Cubic yards.
5	1	60	276
10	3	65	300
15	19	70	322
20	37	75	343
25	60	80	364
30	96	85	385
35	120	90	404
40	158	95	422
45	240	100	441
50	225	105	457
55	252	110	460

The first step to take is to ascertain the quantity of standing-stock immediately available. Taking groups in the same order as in the last example, we should have the following capital-stock and average yearly increment:—

Sub-compartment.	Area, acres.	Age of group	Contents of group, cubic yards.	Yearly increment of group, cubic yards.
1*a*	30	80	10,920	136
2*c*	10	80	3,640	45
6*b*	14	80	5,096	63
2*d*	15	65	4,500	69
3*a*	56	65	16,800	258
4*a*	43	45	8,772	195
4*b*	14	55	3,528	64
3*c*	37	5	37	7
3*d*	7	45	1,428	32
1*c*	12	15	228	15
2*a*	45	30	4,320	144
5*b*	30	30	2,880	96
4*d*	14	30	1,344	45
3*b*	8	30	768	25
1*b*	20	21	740	35
2*b*	31	15	589	39
6*a*	42	21	1,722	82
5*c*	11	0	...	...
6*b*	14	80	5,096	64
5*d*	13	5	13	3
5*a*	55	10	165	17
4*c*	33	10	99	10
Total,	...	...	72,685	1,444

The total contents of the forest being 72,685 cubic yards, and the revolution 60 years, we ought to be able to cut annually at least 72,685 ÷ 60 = 1,211 cubic yards, together with the average increment on the standing stock of the present forest during the revolution. This increment would, roughly speaking, decrease in an arithmetical progression, so that during the first year there would be an increment on $\frac{59}{60}$ of the whole forest, amounting to an increase of 1,420 cubic yards; during the second year, there would be $\frac{1}{60}$ less, during the third $\frac{2}{60}$ less, and so down to the last year, when there would be the increment on $\frac{1}{60}$ of the whole forest, or 1,444 ÷ 60 = 24 cubic feet. Roughly speaking, we may, therefore, say that there would be during the revolution an increment on the old stock of $(1{,}420 + 24)\ \frac{60}{2} = 43{,}320$ cubic yards. On this basis, the

total annual yield would amount to $1,211 + \frac{43220}{60} = 1,211 + 722 = 1,933$ cubic yards; and the yield for a period would be $1,933 \times 20 = 38,660$ cubic yards.

Strictly speaking, the calculation should be made with a view to exploiting the whole of the forest during the present revolution; as, however, it would be decidedly bad management from a sylvicultural point of view to cut 4*a* before 5*a* is completely exploited, 14 acres of the former are left for the first period of the second revolution, and a corresponding area obtained by cutting 6*b* twice during the present revolution.

If the forest were normally constituted, there would be 180 acres of each age-class; the actual state is, however, as follows:—

groups	1—20	years old	occupying	192 acres.
„	21—40	„ „	„	159 „
„	41—60	and over	„	189 „

Amongst the last there is a great quantity of over-mature wood 80 years old, and this surplus is not likely to be compensated by the deficiency in groups of the second category. It is, therefore, pretty certain that the capability of the forest is in excess of the above estimate of 38,660 cubic yards for each period. How much more, or less, it may be, can only be known by actual experiment. We might, therefore, commence by trying a yield of 45,000 yards, and then gradually equalize the periodic yields by transposing groups from one period to another until a tolerably uniform result, such as the following, should be obtained.

No thinnings are taken into account in this example: if any are available, their estimated average yield would have to be added in order to give the full return.

1st Period.

Sub-compartment.	Area, acres.	Average age of exploitation.	Yield of group per acre, cubic yards.	Total yield of group.
1*a*, ...	30	90	404	12,120
2*c*, ...	10	90	404	4,040
6*b*, ...	14	90	404	5,656
2*d*, ...	15	75	343	5,145
3*a*, ...	56	75	343	19,208
4*a* (part of),	25	55	252	6,300
Total, ...	150	...	...	52,469

2nd Period

Sub-compartment.	Area, acres.	Average age of exploitation.	Yield of group per acre, cubic yards.	Total yield of group per acre, cubic yards.
Remainder of 4*a*,	18	75	343	6,174
4*b*, ...	14	85	385	5,390
3*c* (part), ...	2	35	120	240
3*d*, ...	7	75	343	2,401
1*c*, ...	12	45	204	2,448
2*a*, ...	45	60	276	12,420
5*b*, ...	30	60	276	8,280
4*d*, ...	14	60	276	3,864
3*b*, ...	8	60	276	2,208
1*b*, ...	20	51	229	4,584
2*b* (part), ...	24	45	204	4,896
Total, ...	194	...	...	52,705

3rd Period.

Sub-compartment.	Area, acres.	Average age of exploitation.	Yield of group per acre, cubic yards.	Total yield of group, cubic yards.
2*b* (remainder),	7	65	300	2,100
6*a*, ...	42	71	326	13,707
3*c* (remainder),	35	55	252	8,820
5*c*, ...	11	50	225	2,475
6*b*, ...	14	40	158	2,212
5*d*, ...	13	55	252	3,276
5*a*, ...	55	60	276	15,180
4*c*, ...	33	60	276	5,244
Total, ...	200	...	...	53,014

The average annual yield for the first period would, therefore, be 52,469 ÷ 20 = 2,624 cubic yards: for the second period, it would be 52,705 ÷ 20 = 2,636: and, for the third 53,014 ÷ 20 = 2,651.

The yield would, therefore, be fixed for the next 20 years at 2,600 cubic yards in round numbers. At the end of that period, or perhaps sooner, a fresh stock-taking and a revision of the whole scheme would be necessary, and the plan would have to be corrected in accordance with the new estimate. Frequent revisions are evidently necessary in the case of forests with long revolutions, for which the estimate of increment in young groups must always be very unreliable.

The guiding principle of Hartig's method appears to be that one generation should not be benefited at the expense of another: that each succeeding generation should have the full usufruct of the forest, but nothing more. The principle is undeniably sound in regard to public and entailed property, but it certainly cannot be carried out fully without neglecting other equally important considerations. Hartig made no attempt to bring about —no matter how gradually—a satisfactory arrangement of age-classes: in fact, unless the age-classes are normal at starting, it is difficult to see how a proper distribution can ever be attained by his method except by the merest chance. In the example just given, the forest area is of uniform quality, and each period, if normal, should consequently have an area of 180 acres, whereas the affectations vary from 150—200 acres, and will be more abnormal at the end than at the beginning of the revolution. Considering the great quantity of over-mature wood, this regularization of the yield, by holding over large areas of over-mature groups, could only be effected at considerable loss, and the principle of uniform annual yields is obviously carried too far. It is true that Hartig proposed to make good deficiencies, or surpluses, in any period, by increasing, or diminishing, thinnings according to requirements; but, as thinnings cannot be postponed or hurried on to any great extent without injury to the forest, and as they afford in any case comparatively small supplies, it is impossible to imagine that so large a surplus as that of the normal periodic area in the above example could be made good in subsequent periods by increased thinnings.

The impossibility of determining the prospective rate of growth of groups for long periods is a serious defect of Hartig's method, which depends for its accuracy entirely on the correctness of the estimate of increment for all groups to be cut during the revolution. The same uncertainty is experienced in estimating the amount of thinnings available during the revolution. The whole calculation of yield, in fact, rests on far too speculative data to admit of its being safely employed in seedling-forests, while for coppice the much more simple method of annual, or periodic, areas suffice for all practical purposes.

The loss, consequent on not cutting groups at the time of their exploitability, may be just as great by Hartig's method as by the methods of area—in the above example it is greater—but the latter have at least the merit of virtually bringing about the ideal state with the least possible delay, an object which cannot be attained by Hartig's method unless the age-classes are complete at starting. Its advantages as compared with area-methods are that the yield, if the estimate has been properly made, is uniform, and that it affords the fullest scope for natural regeneration by seed.

(To be continued).

PORTABLE FOREST TRAMWAYS; A DECAUVILLE'S TRAMWAY AT CHANGA MANGA.

In the interesting paper on forest tramways which appeared in the June Number of the "Forester," it is suggested that the employment of tramways in the forests of India might have the effect, by diminishing the cost of timber carriage, of increasing the money yield from these forests.

As this is a question of very great importance, an account of the working of a forest tramway at Changa Manga, and the general conclusions derived from a study of the results obtained by its employment, may be useful.

The Changa Manga plantation was commenced in 1866 by the late Dr. Stewart, Conservator of Forests in the Punjab, to meet the growing want for wood fuel, especially for railways. Only a very small area was, however, planted up to 1871, in which year a scheme for its organization and extension on a large scale was drawn up by Mr. Ribbentrop, and this led to an area of some 8,000 acres being successfully stocked in the course of the next few years.

The plantation is situated on a level plateau on the borders of the Bari Doab Canal, by which it is irrigated, and on the North-Western Railway line, 44 miles south from Lahore. Many species have been tried, but sissu has been chiefly cultivated, and the growth practically consists of that species only. Regular exploitations were commenced in 1881-82 in a crop 11 years old, and the forest is now worked by the method of coppice with standards on a rotation of 15 years, about 550 acres being felled annually, leaving 15 to 20 standards as reserves for timber per acre. Where the irrigation has been adequate and regular the growth of the sissu has been remarkably fast, showing 3 to 3·5 years per inch of average radius, and the annual production of wood compared with European forests enormous.

The compartments richest in material were felled first, and yielded when 11 years old, from the fellings alone, 2,624 cubic feet (stacked) of saleable fuel per acre. Including the material previously removed by thinnings, the annual production per acre of these compartments amounted to the high figure of 263 cubic feet (stacked)*, estimated to be equivalent to over 150 cubic feet, solid, of saleable fuel. These compartments had, however, been exceptionally well watered, and the *average* yield per acre from the fellings has now fallen considerably.

Only fuel has been produced up to the present. The railway administration purchases all or nearly all the produce of the fellings. For their purposes it is necessary to cut the wood into

* These figures are taken from the control books kept up at the plantation.

billets 2½ feet long; billets less than 6 inches in girth are not accepted, and billets over 2 feet 6 inches in girth have to be split so as to bring them within these dimensions. For these billets the Railway administration pays Rs. 5-8-0 per 100 cubic feet stacked, when delivered on the railway line and loaded into the trucks.

The *net* price received for this wood after deducting the cost of felling, cutting into billets, delivering and loading comes to about Rs. 4-8-0 per 100 cubic feet stacked, estimated to be equivalent to a net price of Rs. 6-13-0 per 100 cubic feet of solid wood. The smaller material, pieces under 2 inches in diameter, but not the brushwood, for which there is no sale, is sold locally, but only brings in a net income of about 4 annas per 100 cubic feet stacked.

The railway line on which the produce has to be delivered, skirts the plantation, its greatest distance from any part of the planted area being 4 miles in a straight line. A tramway line of a little over this length therefore dominates the whole area.

The conditions for employing a tramway line in Changa Manga are, therefore, exceptionally favorable. The forest is in a compact block at a short distance from the place of consumption of its produce, the ground, which is covered with a complete network of roads, is practically level, and the only obstructions, if we except the canal, which will eventually have to be bridged, are the irrigation channels, which can be temporarily bridged for a few annas. The production per acre is very high, the annual outturn of the exploitations, about 10,00,000 cubic feet stacked, including the smaller wood, is sufficiently large to render a considerable outlay of capital remunerative, and the products of the exploitations are delivered in a form peculiarly suitable for carriage by tramway.

In 1883-84 a firm of contractors purchased the standing crop on some 900 acres of the plantation, and imported, at cost of Rs. 7,648, (including freight from England,) a small portable Decauville's tramway of 16 inches gauge, to work out the produce. Much difficulty had always been experienced at Changa Manga in obtaining country carts in sufficient numbers to work out the wood in the time required. The neighbouring zamindars were willing to work during the slack season when not engaged with their crops; but this did not suit the requirements of the timber work, and higher rates had, consequently, to be paid in order to get carts when there was a press of work. On the completion of the contractor's work in May 1884, the tramway was, therefore, purchased by the Forest Department. The plant was subsequently increased by the purchase of 20 wagons and a mile and-a-half of rails. This tramway has now been in work for two years, and 11,22,000 cubic feet of stacked fuel have been extracted by it.

The plant purchased and its cost are as follows :—

Particulars.	Cost, Rs.	Remarks.
5,133 feet rails, ...		Purchased in May 1884 from Messrs. Robson and Co., Lahore. The wagons, of which the original cost was about Rs. 90 each, are now worth little, as they were not adapted for the carriage of wood and are broken. The rails are, however, still in excellent condition. The present value of this stock is estimated to be Rs. 4,400.
4 Crossings, ...	6,000	
20 Wagons, ...		
1 Box tools, ...		
Freight from Lahore to Changa Manga, ...	77	
2,500 feet of rails in sections, 5 metres long, ... 2,500-0-0 (Rs. A. P.)		
134 feet of rails straight sections, 2·50 metres long, 154-12-0		
13 feet of curved sections, 2·50 metres long, ... 184-4-0	3,118	Purchased in 1884-85 from King & Co. Except the wagon all are still in excellent condition. Estimated present value Rs. 2,800.
2 Crossings, ... 64-0-0		
2 Switches, ... 8-0-0		
1 Turntable, ... 55-0-0		
2 Off-railers, ... 32-0-0		
1 Wagon, ... 90-0-0		
1 Box tools, ... 30-0-0		
Agency fees, ...	75	
Carriage, Karachi to Changa Manga, ...	395	
(£ s. d.)		
5,280 feet rails, ...320-12-11		Purchased in 1885-86, from Messrs. King, King & Co. The present estimated value of this stock is Rs. 7,000.
2 Crossings, ... 4-8-0		
20 Wagons, ... 123-8-0		
1 Crowbar, ... 0-8-0	6,285	
2 Axles on wheels 1-10-0		
Packing, ... 15-13-0		
Total, ...465 19 11		
Freight and insurance to Karachi, ...	515	
Carriage, Karachi to Changa Manga, ...	998	
30 bullocks, @ Rs. 12 each,	360	These cattle were already employed in the Division. They were not specially purchased for the tramway. Twelve have since died. The estimated present value of the remainder is Rs. 336.
10 do. @ „ 12 „	120	
Total Rs., ...	17,893	
Total capital outlay per mile of tramway line with rolling stock, ...	7,130	

The train is worked by bullocks. The rails are laid on the surface of the ground, which is only slightly smoothed to receive them; no sleepers are required. Each section of rails is complete; the parallel rails being joined by steel connecting rods.

The amount expended on working the tramway has been as follows:—

	Rs.
Loading and unloading the wagons, ...	981
Feed and keep of bullocks, ...	210
Carriage and laying of rails in the plantation,...	478
Repairs and other miscellaneous expenses, ...	295
Total expenditure on working, ...	1,964

The total quantity of fuel extracted has been—

1884-85, ...	6,18,000	cubic feet, stacked.
1885-86, ...	5,04,000	„ „
Total, ...	11,22,000	„ „

This fuel was carried various distances, varying from considerably under one mile to nearly two miles. Reducing* each load to a uniform distance of one mile, this quantity is found to be equivalent to 13,20,200 cubic feet carried one mile.

The outlay on work performed by machinery consists, it is hardly necessary to say, in the capital expended on the purchase of the machinery, the interest on this capital, and the pay of the labourers and other expenses of *working* the machinery. In considering the work done by the aid of a machine during a limited period, we must take, instead of the whole capital cost of the machine, a portion of this capital outlay, which we assume to represent the wear and tear or the capital used by the machine during the performance of the particular work considered.

In comparing the results obtained by employing different labour-saving machines, we must therefore take into consideration not alone the labour saved by one as compared with another, but also the capital outlay on the respective machines; and, excluding considerations regarding the quality of the work done, for one machine to be more profitable than another, the money value of the extra work done by it must be greater than the extra outlay necessary in order to employ it.

Assuming that—

Q = Quantity of material to be transported.

d = Distance in miles to which this material is to be transported.

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* I am indebted to Mr. A. L. McIntire, Assistant Conservator of Forests, in charge of the plantation, for these figures showing the expenditure on working the tramway.

C = The cost of a tramway, including wagons, per mile.
c = The cost of the plant of the agency with which it is wished to compare the tramway.
N = The number of years the tramway plant will last in use under the conditions under consideration.
n = The number of years the plant of the other agency will last under similar conditions.
r = The prevailing rate of interest on capital employed in industrial undertakings of the sort.
P = Working expenses on extraction of a unit of material per unit of distance.
p = Ditto ditto for the other mode of transport.

The produce, Q, will cost to transport by tramway to a distance d—

$$PQd + \frac{dC}{N} + \frac{dCr}{100}, \quad \ldots\ldots\ldots\ldots (1).$$

For PQd = Annual working expenses.
$\frac{dC}{N}$ = Wear and tear of plant.
$\frac{dCr}{100}$ = Interest on capital outlay.

Similarly the cost of extraction of the produce by the other mode of transport, which in this instance we will suppose to be bullock carts, would be—

$$pQd + \frac{c}{n} + \frac{cr}{100}, \quad \ldots\ldots\ldots\ldots (2).$$

It is evident that d, the limit of distance to which it will be profitable to make a tramway, or the distance at which one mode of transport is as profitable as the other, can be determined from the equation—

$$PQd + \frac{dC}{N} + \frac{dCr}{100} = pQd + \frac{c}{n} + \frac{cr}{100}, \quad \ldots\ldots\ldots\ldots (3).$$

If the tramway is f times as effective as the bullock carts or other agency with which it is being compared, then P in the above equation is evidently equal to $\frac{p}{f}$. Substituting this value for P in the equation we get—

$$pQd\left(1 - \frac{1}{f}\right) = \frac{dC}{N} + \frac{dCr}{100} - \frac{c}{n} - \frac{cr}{100}, \quad \ldots\ldots\ldots\ldots (4).$$

But this expression $pQd\left(1 - \frac{1}{f}\right)$ is the money value of the *labour* saved by employing the tramway. For the cost of transporting the material Q to a distance D by cart is pQd. By employing the tramway we can transport f times the quantity of material or fQ to the same distance at the same cost of pQd. Therefore the cost of transporting the material Q to this distance by tramway is $\frac{pQd}{f}$; therefore, the saving in cost of labour on transport by employing the tramway is $pQd - \frac{pQd}{f}$ or $pQd\left(1 - \frac{1}{f}\right)$.

We can calculate the effectiveness of the tramway as compared with any other mode of transport from this equation—

$$\frac{1}{f} = \frac{pQd + \frac{c}{n} + \frac{cr}{100} - \frac{dC}{N} - \frac{dCr}{100}}{pQd}, \quad \ldots\ldots(5).$$

It may often happen that the machine or agency, bullock carts, for instance, with which we wish to compare the results of the tramway has hitherto been paid for by contract, so that we have no means of ascertaining the separate values of each of the quantities in the expression $pQd + \frac{c}{n} + \frac{cr}{100}$. But this contract rate, where the rate is a fair one, and not the result of a monopoly, is equivalent to the value of the whole expression and may be substituted for it.

If R be this rate, $QR = pQd + \frac{c}{n} + \frac{cr}{100}$, and the expression (2) becomes, where R = rate for unit of distance,

$$PQ + \frac{C}{N} + \frac{Cr}{100} = QR, \quad \ldots\ldots(6),$$

and equation (5) becomes

$$f = \frac{pQ}{QR - \frac{C}{N} - \frac{Cr}{100}}, \quad \ldots\ldots(7).$$

Some modifications are necessary in applying these equations to calculate the *average* annual cost of the extraction of the *annual* yield of forest by tramway. For in this case the distance to which the material is carried varies from year to year, while the length of rails, the chief item in the capital expenditure, remains the same.

In the preceding equations, d, the distance to which the material is transported, has been taken as the length of rails. But in calculating the annual charge on account of the tramway, we should take, to calculate the working expenses, the *average* distance the material would have to be transported during the *whole rotation*, while to calculate the capital outlay we must take the *greatest* distance or greatest length of rails required.*

If l = the maximum distance or length of rails,
d = the *average* distance to which the material has to be carried during the rotation,

* Assuming, the yield per acre to be *uniform*, and a_1, a_2, a_3, &c, to be the areas of the compartments; d_1, d_2, d_3, &c., to be the distances of these compartments from the place of consumption of the produce; A the area of the whole forest; the *average* distance to which the produce of the fellings would have to be carried during the whole rotation would be

$$= \frac{a_1 d_1 + a_2 d_2 + a_3 d_3, \&c, \&c}{A}$$

then the average annual cost on account of extracting the produce Q by tramway will be—

$$PQd + \frac{lC}{N} + \frac{lCr}{100}, \quad \ldots\ldots\ldots\

The *greatest* distance to which material has to be transported during a rotation, or the length of rails required is 4½ miles—

$$\therefore l = 4{\cdot}5.$$

The least distance of the forest from the railway is zero ; consequently

$$k = 0.$$

From equation (8) it will be found that the average cost of extracting an *annual* yield of 10,00,000 cubic feet stacked of fuel during a whole rotation will come to—

$$0{\cdot}00148 \times 10{,}00{,}000 \times 1{\cdot}75 + \frac{4{\cdot}5 \times 7130}{10} + \frac{4{\cdot}5 \times 7130 \times 4}{100}$$

or $2{,}604 + 3{,}202{\cdot}5 + 1{,}283{\cdot}4 \doteq$ Rs. 7,089·9. This comes to 11 annas 4 pie per 100 cubic feet stacked.

The rate charged by contractors for extracting fuel by country cart from the plantation has varied from Rs. 3 to Rs. 5 per 1,000 cubic feet, stacked, for the compartments near the railway line, and from Rs. 5 to Rs. 6 or 7 for the more distant compartment across the canal. As the higher rates would undoubtedly have to be paid in order to get carts in sufficient numbers to extract the produce in anything like the same time as can be done by tramway, we must, for purposes of comparison, make use of the *higher* rates. At an all round rate of Rs. 5 per 1,000, the *average* cost of extracting the annual yield of the plantation by country cart would come to Rs. 5,000 ; or 8 annas per 100 cubic feet (*stacked*).*

At this rate for country carts the limit of distance to which it will be profitable to carry the tramway will similarly be found from equation (10) (as $k = 0$) to be—

$$\frac{5 \times 1000}{\frac{0{\cdot}001488 \times 10{,}00{,}000}{2} + \frac{7130}{10} + \frac{4 \times 7130}{100}} = 2{\cdot}9 \text{ miles.}$$

In the above calculations the interest on capital outlay has been included, as this is necessary in order to compare the relative value of the machines. But in practice this interest would not appear in the recorded expenditure on account of the timber works. The income would be reduced periodically, every 10 years or so, by the amount expended on the purchase of the plant required, and for other years the expenditure would be only the actual cost of working the tramway.

Not including interest the *actual* cost of exploiting an annual yield of 10,00,000 cubic feet (stacked) of fuel from the Changa Manga plantation by tramway would amount, on an average for the whole rotation, to Rs. 5,806·5 instead of Rs. 5,000, which would have to be paid for its extraction by cart. As the work can be done with much greater certainty and in half the time by the tramway than it could be done by carts, the employment

* The weight of green sissu is about 65 to 70 lbs. per cubic foot; 100 cubic feet stacked of fuel pieces contain about 66 cubic feet *solid*, and weigh from 3,000 to 4,600 lbs. according to its state of dryness.

of the tramway has improved the position of the produce in the market, and, *indirectly* diminished the cost of the timber works by diminishing the cost of their supervision. The value of this supervision, the time saved to the *establishment*, is certainly worth more than Rs. 806 extra expenditure annually, which the employment of the tramway involves. The Changa Manga tramway may, therefore, be pronounced a financial success.

But it cannot be said that it has increased the money yield of the plantation. Nor would it appear possible that, in the majority of forests this could be the case in India; though as the figures here quoted refer to the transport of firewood only, it may be that saving of labour is much greater in the case of large timber.

But labour saving machinery, which is profitably employed in European countries, where labour is dear and capital abundant, cannot always be profitably introduced into countries like India, where labour is cheap and capital scarce. In India machinery is much more expensive than in Europe, and the interest on capital is higher. The extra cost involved in introducing new machinery is, therefore, much greater. On the other hand, as unskilled labour is cheap, the money value of the labour saved which has to meet and pay for the capital outlay on machinery is very much less than in Europe.

It must also be remembered that capital expended on machinery for the extraction of timber is heavily handicapped by the fact that, in very few forests can timber extraction be carried on during the whole or even the greater part of the year. During this period of rest the capital spent on machinery used in the transport of timber is unproductive. This capital outlay in the case of a tramway increases directly with the greatest length of rails required at *any time* during the rotation. With wheeled vehicles, or draught animals, the capital outlay does not increase to anything like the same extent; and the average expenditure for the whole rotation depends on the *average* distance to which the annual outturn of material is transported, and not on the greatest distance to which it may have been necessary to transport it at any one time.

Thus in Changa Manga, although the circumstances are exceptionally favourable, the annual charge on account of the capital outlay on the tramway is 64 per cent. of the total expenditure on account of the extraction of timber, and although the average distance to which the material has to be transported during a rotation is only one mile-and-three-quarters, four-and-a-half miles of rails have to be purchased.

From these facts we may infer that, in India, there are very few cases in which tramways or other expensive machinery for the transport of timber will be able to compete with the ordinary modes of conveyance of the country.

W. E. D'A.

NOTE ON THE ADVISABILITY OF APPLYING THE METHOD OF COPPICE WITH STANDARDS TO SOME FORESTS IN THE CEDED DISTRICTS.

THE Ceded Districts of the Madras Presidency comprise the Districts of Cuddapah, Kurnool, Bellary and Anantapur, and lying between the two Native States of Mysore and Hyderabad, form an isolated block, whose forests though differing a good deal in the arid taluks of Bellary from the moister Nallamalla hills in Kurnool, yet are of a sufficiently uniform character to allow of the same mode of treatment being applied to the greater portion of their area.

The area of forest in this region, hitherto notified as reserved forest, or now under settlement as such, is about 5,000 square miles. The chief characteristic of these forests is their poorness in valuable trees. An exhaustive list of the Forest Flora is published in the Madras Annual Report for 1884-85, but of the good timber trees therein enumerated, teak, blackwood, sandal and *Shorea Tumbuggia* are so rare as to be negligible quantities for the forester, and red sanders is confined to one corner of the Cuddapah district, where it grows gregariously, and forms a class of forest requiring special treatment, of which I will not speak further in this note.

The ordinary run of forest to which I wish to show the advisability of applying the method of coppice with standards varies in character from mere thorny scrub 10—20 feet high, presenting scarcely a single tree with any future before it, to fairly good deciduous forest 40—80 feet in height, which at first sight appears to contain a good proportion of trees reckoned valuable in the district, *viz.*, *Pterocarpus Marsupium*, *Terminalia tomentosa*, *T. Chebula*, *Hardwickia*, *Anogeissus latifolia*, *Bassia*, satinwood, ebony, &c.; but on closer examination it is found that almost without exception every tree over 4 feet girth is unsound, and that there is a lamentable absence of young poles, and that seedlings are entirely absent or are only those of the hardier soft-wooded trees.

I think it will be seen from what I have said above that the forests are very second rate compared with either the sal and deodar forests of Northern India, or the teak forests of the Western Ghauts, that they never will repay very intensive treatment, and that the amènagiste must try to settle them on some simple system under which all the operations can be performed by low paid native subordinates—Foresters and Forest Guards.

The two following observations that I made first led me to think that in treating forests in this dry region, where the rainfall is scanty and the ground always hard, we should seek their regeneration more by coppice shoots with seedlings as auxiliaries than by seed alone:—

"(1). In the Cuddapah district about 10 years ago certain portions of forest, mostly scrub, were reserved and enclosed with expensive fences and carefully protected against cattle and fire. What has been the result? The trees have grown it is true, but at what rate? It has been variously estimated at $\frac{1}{10}$ to $\frac{1}{4}$ ton per acre per annum. The trees are low-branched and flat-topped, and seedlings are almost entirely absent, on account I think of the low cover and hard soil.

"(2). Again, I found that on boundary lines cut in the same class of forest, coppice shoots come up with the greatest vigour, and are not totally destroyed as seedlings would be, even when fire passes through them in their first year."

The conclusion that I came to was that if these reserves had been cut clean over as soon as they were fenced in and fire-protection assured, we should have at the present date a fine young coppice growth, which could either be maintained as such, or gradually converted into high forest, instead of a miserable scrub incapable of reproducing itself by seed and growing every year less apt to reproduce itself by coppice shoots.

Having treated of cultural reasons, I will now pass to others not less important, *viz.*, the demands of the timber trade and facilities for exploitation and control. With regard to the former, the most important consumers of forest produce are without doubt railways, of which the Ceded Districts contain a very considerable mileage. The Madras Railway runs through from north to south, the Bellary-Kistna and Southern Mahratta system crosses from east to west, and there are other famine lines surveyed and sanctioned which will shortly be constructed. But these railways are laid with iron sleepers, and for the construction of their buildings and rolling stock they prefer Burma teak, which is at present obtainable in Madras at a very low price, to the inferior local woods. Thus the only local product they consume is firewood, and there is not the slightest chance of coal being substituted for wood so long as wood is available at present prices. The local demand is for firewood for domestic purposes, boiling sugarcane and smelting iron, (though this latter industry is dying out,) for timber of small scantling (9″ × 6″ × 16′ being about the largest size in demand), and for poles and bamboos. For poles of good sorts the demand is very great.

I submit that the system of coppice with standards is eminently suited for supplying these demands. The revolution should be long 25—30 years, which would produce poles 6—12 inches in diameter; those of the better sorts would be used for building purposes, construction of carts, &c., &c., and the rest for firewood. The reserves of two and three revolutions would yield the kind of timber in demand in the neighbourhood.

Of course this system could not be applied to the whole area, as in the more remote portions of the forest timber alone is marketable, but still there are about 500—600 square miles, say

10 per cent. of the whole forest area which are sufficiently near to railways and small towns to insure the sale of the firewood.

The advantages of this system over all others in the way of police, control, and method of executing the fellings will be best shown in taking them one by one and demonstrating the difficulties that lie in the way of their application.

The system of "thinnings" or natural "reproduction" requires not only skilled supervision, but also very intelligent men to mark the trees that are to be felled in every operation which the revenue derived from these forests would never justify us in employing; to say nothing of the expensive survey on a large scale which would be a necessary preliminary. Besides this, I do not think that the poorer scrub is capable of reproducing itself by seed, and it would in any case be necessary for it to first pass through two or three rotations of coppice so as to get a sufficient number of standards of the good sorts capable of bearing seed.

It would be equally difficult to apply the primitive method, as the chief products required are firewood and poles, and the size of the trees is so irregular, that the possibility would have to be fixed by volume, which is always dangerous, and here with our very limited knowledge of the annual production might lead to very disastrous results.

The "cut and come again," or license and voucher system, which was in vogue in these forests when the object of Government was simply to obtain revenue, may be condemned without further argument. A modified form of it, in which five or six of the principal trees are reserved from felling, might be retained in the more remote parts, which will, however, be chiefly worked for grazing, which these forests will have to provide for to a very large extent.

In working under the system of coppice with standards, the following advantages may be enumerated:—

(1). An elaborate survey will not be necessary either of the ground or of the crops.

(2). The system gives very good results under very rough treatment. The marking of standards can be done by Forest Guards subject to subsequent inspection by Forester or Ranger. On this point it stands far above any other system.

(3). The controlling officer, after a compartment has been cut, can see at a glance if the work has been properly done, and that no fraud has been committed by the contractor, which is very difficult to do when selection fellings and thinnings are going on over a large area.

(4). This system more than any other enables the Forester to increase the proportion of superior species at the expense of the inferior ones, a result which is often reversed under other systems, where the tendency is always for the strongest to take possession of the soil.

(5). Lastly, but by no means least, it is possible to substitute sales of standing crop for departmental working, without which it is difficult to manage forests on any other system, and regarding which I think experience has shown that in India it does not pay in forests where inferior timber, poles and firewood form the only products.

KONDA DORA.

NUTRITION OF CUPULIFERÆ.*

WE wish to give some account to our readers of a recent discovery, which bids fair to exercise a complete revolution in the field of vegetable physiology. The subject is of primary interest to the Foresters, as it concerns one most important forest species, presenting as it does the question of the nutrition of the oak, beech and hornbeam from an entirely unsuspected point of view. A new light has been thrown on this question, the difficulty of which naturalists have had good reason to believe were smoothed away since Sach's famous experiments.

For this discovery we are again indebted to Germany, a country which may be styled the laboratory of natural science, and which, thanks to the untiring investigations of the scientists of the Wurzburg Institute, particularly has so largely contributed to the advancement of our knowledge of vegetable physiology.

Dr. Frank, a learned professor of the Berlin University, is of opinion as the result of numerous experiments, that various ligneous species are nourished by the intermediary of underground fungi. This appears an odd theory: hitherto we have been taught that all trees obtain such constituent elements of these compositions as are procured from the soil, by means of their slender fibrils. This is not so however: all trees do not act thus. Oaks especially do not directly obtain the smallest nutritive particle from the soil; but there exists around their roots a complete envelope formed by a fungus, to which the functions of nutrition are exclusively confided. This envelope is intimately connected with the root, growing with it acts as a morphological organ, Dr. Frank has called *mycorhiza*.

This mycorhiza is in the form of a pseudo-parenchyma composed of several layers of cells irregularly interlaced and forming a dense reticulation. Not only does it cover very completely the epidermis of the root, but it penetrates into the interior of the epidermal cells. The formation of root-hairs is totally prevented, and what might be taken to be the latter are filiform ramifications of the fungus arising from prolongations of its internal cells.

The growth of the envelope follows that of the root in a par-

* Translated from the "Revue des Eaux et Forêts" for March 1886.

allel manner; one line indicates the termination of one and the other, so that the fungus remains in close proximity to the growing point. Nevertheless the physiological organic union occurs very little behind this point, and only at that spot where the longitudinal growth of the free cells is terminated.

When a young germinating plant is examined, the presence of this fungus is not at first apparent. It is first seen on the young lateral roots, grows slowly on these, persists for a short period only, and in any case is destroyed when these organs attain maturity.

„The *mycorhiza* gives rise to a striking alteration in the root growth. While roots free from this parasite remain thin and elongated, producing far-spreading lateral ramifications, the mycorhiza grows very slowly and engenders short and thick roots, from which exactly similar ramifications arise, the whole resembling a growth of coral.

Dr. Frank's observations give as result—that the Cupuliferæ and Corylaceæ (oak, beech, chestnut, hornbeam, hazel) are always attacked by this parasite; that the Salicineæ (willows and poplars) are frequently so; and that finally the birch, alder, plane, walnut, robinia, lime, maple, ash, elder and generally all shrubs, are never so attacked.

The author of this theory has endeavoured to determine in what category this fungus should be included: it appears that it would probably be among the tuberaceæ or the gasteromycetes. Until a careful examination has been made of this fungus growth while fructifying, it will be impossible to give a definite answer to this question. The mycorhiza of a truffle-bed has been examined, and absolutely no difference found between it and the mycorhiza described above. Dr. Frank believes, therefore, that he is justified in asserting, that it is really this fungus which produces the truffle, and that, if the latter be the rarer of the two, it is because its fructification is usually prevented by various external conditions.

Finally, the author of this theory expresses himself as follows relatively to the physiological importance of the mycorhiza:—

"The mycelium of this fungus must be regarded as a parasite upon the root of the trees, from which it borrows the carbonised materials assimilated by the leaves. On the other hand it furnishes the tree with all its mineral elements, together with the water which it requires: alone it fulfils this *rôle*, because alone it is in contact with the soil. Thus these two vegetable organizations exist side by side and without any mutual injury, assist each other."

We have sketched in a summary manner the new theory which Dr. Frank has imagined. This doctrine is entirely in accordance with the scientific ideas of the day. Have not, in fact, chemistry and medicine during the last few years, generalised the important *rôle* played by fungi in natural phenomena?

And now the science of sylviculture is, in its infancy, becoming complicated by the study of these inferior organisms.

Dr. Frank is not a forester; but who knows that he will not cause an immense progress in sylviculture; who can foretell the practical consequences which his discovery may lead to. It rests with us foresters to deduce them: a new field of study is open to us; let us enthusiastically apply ourselves to the task!

ROUGH NOTES ON THE TUSSUR SILK-WORM IN ITS DIFFERENT STAGES.

THE first collection of cocoons was made by me in October on my coming out to the forests. They were gathered from different kinds of trees, for instance, the sal, asyna, jáman, chilla, carya, &c.

I put them away carefully in a box, examining them daily. They remained in a dormant state till towards the end of March, when the first change was noticed. The development from the chrysalis state to the moth takes place inside the cocoon.

This can be seen by carefully cutting the cocoon in two, taking care not to injure the chrysalis. The thick skin of the chrysalis gradually becomes soft at the time of change, and the exit is made from the upper or head portion. The moth moistens the end of the cocoon, which, being softened, enables it to work its way out, leaving the shell inside the cocoon.

It is then in a very cramped state, but in about 15 minutes the wings spread out, measuring from 6 to 8 inches, though it cannot fly for three or four hours.

The female can be distinguished from the male by its feelers, which are like tiny ferns, very thin and narrow, those of the male being broad and thick. The female is about a third longer than the male.

As is the case with all moths, their flights are only made at night. In the evening, or about dusk, I put out several females, tying them, by their right wings, with pieces of thread some 18 inches long, to trees and bushes out in the open, on the skirts of the forest. The use of the long thread was to enable the moth to flutter about. The moth flight commences from about midnight, and they fly about till about 3 A.M., when the male, attracted by the flutter of the female, consummate their brief marriage, remaining in position till sunrise, when he leaves her, and returns to the shade of the dense jungle.

The female moth commences to lay immediately, and will lay from 150 to 200 eggs, both male and female dying in about 15 days. If the eggs are not fertilized, they flatten out and dry up very shortly, but if all right, hatch in about a fortnight.

When first hatched, the caterpillars are of a yellowish brown colour, and the yellow colour deepens as they approach their first change, about the 9th day; they then spin a little silk on to a branch or leaf on which they thus obtain a firm hold. They then burst their skins and crawl out, leaving the old skin behind.

The second change commences about the 20th day, the third about the 30th, and the fourth and last change about the 40th day, each change taking about three days to complete.

During the changing periods they eat nothing, but during the rest of the time feed ravenously on green leaves, and a caterpillar after his last change will every day consume a fully developed sal leaf. In about 15 days after the last change, the caterpillars commence spinning their cocoons, getting into the chrysalis state in some six or eight days.

Some caterpillars I reared were hatched on the 28th March. They commenced their first change on the 6th April and finished on 8th; the second change commenced 17th April, finished 19th; the third change commenced 26th April, finished 28th April; the fourth and last change commenced 7th May, finished 9th May; and they spun their cocoons on the 19th May. Four crops of cocoons can be gathered in the year, *viz.*, in April, June, August and October.

I am sending you a box of moths, and you will see that they are differently coloured. At first I attributed this to the caterpillars feeding on the leaves of different trees; for instance, the reddish coloured ones on asyna, the yellow on jáman, &c., but I find I was mistaken, as the batch of caterpillars I just reared were all fed on sal, but the moths were of different colours.

The cause I cannot explain. I am also sending you, preserved in spirits of wine, specimens of the caterpillars in their different stages. I have already stated that the caterpillars feed ravenously on the leaves of certain trees, but whether that does any damage to the trees themselves I cannot say. I have also noticed that after the caterpillar has changed skin, he turns round and eats a portion of the old skin. I noticed it on several occasions with the batch I just reared.

DUDWA GHAT,
27th June, 1886.

C. W. ALLAN.

JJ Review

FIRE CONSERVANCY IN PROVINCES UNDER THE GOVERNMENT OF INDIA, 1884-85.

From some papers recently circulated by the Government of India, we observe that the total area successfully protected from fire in the hot season of 1885 amounted to 3,315,060 acres, or 5,180 square miles. The cost of this protection was Rs. 1,03,481. This gives an average cost of 6 pies per acre, or Rs. 20 per square mile.

As regards cost, Pegu heads the list with an expenditure of 19·57 pies per acre; and Berar comes last and wins, (as in a donkey race at a Gymkhana,) with an expenditure of 1·48 pies per acre.

There is one forest tract in Pegu, Myodwin, consisting of 40 acres, which cost Rs. 41 to protect, or 197 pies per acre; but this record is easily beaten in Tenasserim, where a tract of 73 acres, named Dali, cost Rs. 140 to protect, or 368 pies per acre!

From the bare figures given by the Government of India, it is, of course, impossible to hazard even a guess as to what manner of forest this may be in Tenasserim, which costs nearly Rs. 2 an acre to protect; but it would be extremely interesting to know the exact details of this high expenditure in Burma, just as it would be to have a clear understanding as to the local circumstances in Berar, which result in fire conservancy being carried out at an average cost of one-and-a-half pies per acre. That Berar and the Central Provinces, both with a very long, hot and dry fire season, should exhibit the lowest cost is a remarkable fact, and is worthy of further elucidation, and we recommend this point to the Divisional officers of those provinces, in the hope that they will enlighten the readers of this Journal.

On examining the figures given for Assam, we find that there is an area of 8 acres, called Bamoni Hill, which in 1884-85 cost Rs. 26, or 624 pies per acre to protect successfully. In Berar on the other hand, the Wun reserve of nearly 4,000 acres cost last year 0·6 pies per acre to protect; while the Gugumal reserve of 115,000 acres was protected at a cost of about 0·7 pies per acre. These figures seem to us worthy of explanation. We give tabular statement showing the areas successfully

protected in the Provinces under the Government of India (Ajmere and the Punjab are absent) and the cost thereof:—

Provinces.	Area successfully protected in acres.	Cost in Rupees.	Cost in pies per acre.
Berars, ...	654,745	5,059	1·48
Central Provinces, ...	895,361	18,616	3·95
Bengal, ...	729,924	16,122	4·24
School Circle, N.-W. Provinces, ...	227,706	10,361	8·73
Oudh „	251,490	11,865	9·01
Central „	252,475	15,852	11·85
Tenasserim, British Burma, ...	73,630	4,905	12·79
Assam, ...	127,091	10,302	15·56
Pegu Circle, British Burma, ...	102,638	10,459	19·57
Total, ...	3,315,060	1,03,481	Av. 6 pies per acre.

III Official Paper.

REPORT ON THE DEOTA SLEDGE ROAD, JAUNSAR DIVISION, SCHOOL CIRCLE, N.-W. PROVINCES.

CHAPTER I.

Introduction.

The Deota forest.—The Deota forest is situated on the right bank of the river Tons, 43 miles from Chakráta, with which it is connected by means of the Tons-Chakráta 6 feet forest road. This forest is one of those leased from the Rája of Tihri-Garhwál; the old lease, which expired in 1884, having just been renewed for a further period of 20 years.

The area of the forest is 4,937 acres, about one-half, or 2,500 acres, consisting of nearly pure deodar. On about one-fourth of this area the deodar is situated on moderately sloping ground, but over the remainder the ground is extremely steep and in some places precipitous.

As a rule, the deodar zone is comprised between 7,000 and 9,000 feet elevation, but the fellings have principally taken place at an average altitude of about 8,000 feet.

The forest has been divided into 10 blocks having natural boundaries, all of which are drained by the Bagiár stream, which joins the Tons at Thadiár. The average distance of the deodar zone from the Tons river is about 6 miles, those portions felled up to 1881-82 being slightly nearer; whereas the areas felled since that time, and especially those tapped by the new sledge road, are nearly 7 miles from the Tons river.

Working of the Deota forest.—After a careful inspection of the Deota forest by Messrs. Greig, Bagshawe, and Rind, fellings were commenced in March 1876, on the completion of the timber operations at the neighbouring Mandhól and Lambatách forests.

The first work of importance undertaken was the construction of a good 6 feet road from the Tons-Chakráta road at the 34th mile from Chakráta. The length of this section is 9 miles, and the cost amounted to Rs. 4,468, some heavy blasting work being necessary.

The opening out of the forest by means of a system of 2 feet paths was next undertaken, which have since been steadily improved and extended, till the whole forest is now intersected by a complete net-work of export and inspection paths.

The next work undertaken was the construction of the timber slide and the wire rope suspension bridge over the Tons at Thadiár. The span of this bridge is 146 feet, and the original cost was Rs. 2,864. It was constructed by Messrs. Bagshawe, Rind, and Ballantine, and is a very substantial structure, no repairs having been required up to the present. A comfortable bungalow for the officer in charge was then built at Deota, together with the necessary number of godowns, office and other buildings.

Valuation survey and working of the forest.—The total number of standing trees over 6 feet in girth contained in the Deota forest, ascertained by means of the valuation survey, which was completed in 1880, is 28,739; but this includes a very large number of trees growing above precipices and not available for export. Out of this number the following trees have been felled up to the end of March 1885 :—

Green trees, ...	4,702
Dry „	4,578
Total, ...	9,280

The outturn in sleepers has been as follows up to the 31st March, 1885 :—

Broad gauge sleepers 10′ × 10″ × 5½″, ...	1,35,000
Metre gauge „ 6′ × 8″ × 4½″, ...	2,72,800

all of which have been brought down the timber slide.

This outturn gives an average of about 30 broad gauge for 55 metre gauge sleepers per tree, which data nearly agree with the results obtained for the years 1880-81 to 1884-85, during the time I have been in charge of the works.

Natural and artificial reproduction at the Deota forest.—It may be here stated, with reference to the fellings, that natural reproduction of deodar in the Deota forest is very satisfactory: so that all available trees, or about one-third of those enumerated by the valuation survey, may be removed within the next five years without injury to the forest. Since the timber works commenced, planting and sowing operations have been steadily undertaken, and the number of deodar planted and sown since 1881-82 is as follows :—

Trees planted, about	25,000
Pits sown „	5,000
Total, ...	30,000

Probably about one-half of the above number of plants will eventually establish themselves; but in deodar planting in this part of the Himálayas five or six years must be allowed to lapse before the results can be predicted with certainty.

Labour available, food supply, &c.—All labour for the working

of the Deota forest has to be imported from a distance, as there are only one or two villages in the immediate neighbourhood.

The sawyers, as a rule, are imported from the Punjab and Kulu, and the other workmen come from distant villages situated in the Upper Tons and Jumna valleys, also from Garhwál and Basháhr. All food for the sawyers and for about one-third of the workmen has to be brought from Chakráta or the Jumna valley at considerable cost; the rates allowed at Deota for rice and atta being only 10 seers per rupee, which on the latter commodity represents a loss of one rupee per maund to Government. Under these circumstances, therefore, the rates paid for labour in this forest are considerably higher than those paid in Jaunsár, or in other forests of the School Circle.

The Deota timber slide.—I have already mentioned that the most important primary work executed at this forest was the construction of the timber slide, and a few remarks on its construction and general working may not be out of place here. The timber slide is constructed on nearly the same principles as the Mandhól and Lambatách slides, regarding which attention is invited to Mr. C. Bagshawe's interesting report contained in the *Gazette of India* of 29th November, 1873.

It should, however, be noted, to commence with, that the difficulty of constructing the Deota slide in the rough bed of the Bagiár stream far surpassed any difficulties which had to be grappled with either at Mandhól or at Lambatách, as numerous precipices and landslips had to be dealt with.

Construction of the slide.—The construction of the slide was commenced in 1876 and completed in 1878, under the direct supervision of Messrs. Bagshawe, Rind, and Ballantine, and the task was by no means a light one.

There are in all eight main bridges, varying from 30 to 70 feet in length; also several heavy rock cuttings and retaining walls 20 to 25 feet high, besides numerous smaller bridges crossing the Bagiár stream.

The slide consists of the usual trough composed of three beams, 12′ × 13″ × 5″, roughly jointed and firmly wedged into block sleepers. The timber used for the slide beams is chir (*Pinus longifolia*), this being the timber nearest to hand, and at the time of construction it was estimated that those beams would last for six or eight years.

It has, however, been found that, with the exception of the beams which are embedded in the ground in some places, and are thus constantly kept wet, none of them have lasted longer than three or four years: so that the whole wood-work of the slide has been renewed at least once since it was at first constructed. The reason why the slide cannot always be kept wet is that there is hardly any water in the Bagiár stream at certain seasons; repairs have also to be effected, so that the drying up of the slide is sometimes unavoidable

Chír timber was also, unfortunately, used for the main beams of most of the bridges; but neither have these lasted for more than four or five years, and have since all been renewed either with deodar, kail (*Pinus excelsa*), or tún beams. It is presumed that these timbers were not used at first on account of the cost of bringing them from a distant part of the forest; but had they been then employed several pecuniary and other advantages would have resulted, as the sliding operations have often been interrupted in the middle of the working season by the sudden collapse of a bridge.

It should also be noted that the damp and close atmosphere of the Bagiár nála is particularly favourable to the rapid decay of timber of the very best quality, and even deodar will probably not last there for more than 10 or 12 years.

The inside measurement of the timber slide is 13 inches wide by 8 inches high, as it was originally constructed for the sliding of broad gauge sleepers; and a lighter slide would suffice if only intended for the export of metre gauge sleepers measuring 6′ 3″ × 8¼″ × 4¾″.

Length, gradient, and cost of the slide.—The total length of the Deota slide is 12,192 feet, but in 1878 it was extended upwards for about 1,000 feet; owing, however, to the confined nature of the upper part of ravine and consequent want of waterway, this section was swept away during the rains of 1879, and no attempt has since been made to reconstruct it.

The gradient of the slide varies from 5 to 22 degrees, and the total fall (*see* accompanying Plan of the Deota forest) is 1,300 feet, the best gradient being apparently about 15 degrees.

		Rs.
The original cost of the Deota slide was	...	26,000
And the following amount has been spent on repairs up to 31st March, 1885,	...	7,988
Grand Total cost,	...	33,988

Working of the timber slide.—The slide is worked by means of a good flow of water, which is let in from the Bagiár nála by means of troughs situated about a quarter of a mile apart.

When the slope is steep, very little water is, of course, required, as the sleepers on a gradient of 22 degrees slip along by themselves, and in such places the use of the water is principally necessary to prevent the slide from catching fire through friction. In places, however, having a gradient less than 18 or 20 degrees a good flow of water is absolutely necessary to make the sleepers move along.

The slide is principally worked during the rains, as there is not sufficient water available at other seasons, except during February, after the melting of the snow, when sliding is sometimes undertaken.

The sleepers are carefully launched at the head of the slide at intervals of about half a minute, care being taken to place them on their broad sides; otherwise there is a risk of jamming the slide, if a metre gauge sleeper on its narrow side overtakes one on its broad side: for, as already explained, the slide was originally constructed for broad gauge sleepers. When there is a good supply of water, a sleeper takes about ten minutes to travel down the whole length of the slide, or about 2¼ miles: so that when the slide is in good working order, 1,200 sleepers can easily be slid in one working day of 10 or 12 hours. Ten chaukidárs are kept at intervals along the slide during working hours, and regulate the water supply and remove boulders which sometimes fall in. They also assist the sliding of the sleepers at certain places where the gradients are slight or where the water supply fails, and keep a look-out for landslips, which frequently occur during the rains and suddenly block the slide. The services of a carpenter are also required to look after petty repairs, as the vibration caused by the rapid passage of the sleepers tends to loosen the wedges and occasions to leakage.

On arrival at the Thadiár depôt on the bank of the Tons river, the sleepers are thrown out of the slide by means of a kind of table provided with a slanting beam, against which the sleepers strike, and are then stacked by a gang of coolies. After the monsoon, or during February, the sleepers are slid directly into the Tons river: but this plan cannot, of course, be followed during the height of the floods.

Financial result of the Deota slide.—Since the slide was completed in 1878, the following timber has been exported by its aid:—

	No.
Broad gauge sleepers, ...	1,35,000
Metre gauge „	2,72,800

The cost of sliding these sleepers has apparently been as follows:—

	Rs.
1,35,000 broad gauge sleepers, at 6 pie per sleeper,	4,218
2,72,800 metre gauge „ „ 3 „ „ ...	4,262
5 per cent. commission to contractors, ...	424
Total, ...	8,904

Had there been no timber slide, the actual cost of carriage by means of coolies over this section of the export line would probably have been as follows:—

	Rs.
1,35,000 broad gauge sleepers, at 3 annas per sleeper,	25,312
2,72,800 metre gauge „ „ 1 anna „	29,837
5 per cent. commission to contractors, ...	2,357
Total, ...	57,906

The financial result of the slide up to the end of 1884-85, therefore, stands thus—

		Rs.
Estimated cost of carriage of sleepers exported from the Deota forest by means of coolies, as detailed above, ...		57,906
Deduct—	Rs.	
Original cost of the slide, ...	26,000	
Cost of repairs, ...	7,988	
Cost of sliding the sleepers exported,	8,904	
		42,892
Net saving effected by the slide up to end of 1884-85,		15,014

It should also be noted that, had no slide been constructed, there would have been great difficulty in transporting the sleepers to the bank of the Tons river at the proper seasons on account of the scarcity of labour.

It is estimated that about 3,00,000 more metre gauge sleepers will probably be exported from the Deota forest by means of the slide, and this represents a further saving of Rs. 23,637, at 1 anna 3 pie a sleeper, as exhibited on the margin.

	A.	P.
Cost of carriage of metre gauge sleeper per coolie, ...	1	9
Deduct—		
Cost of export by means of the slide, sliding by daily labour, As	0	2
Repairs of slide, per sleeper, „	0 4	0 6
Net saving, ...	1	3

If this estimate prove correct, the total saving, on the Deota timber works, resulting from the use of the slide instead of coolie labour, will be above Rs. 38,000.

It is evident, however, that the construction of an expensive timber slide will only pay for the working of a large forest; for if the quantity of timber to be transported be small, the cost of construction and repairs of the slide will prevent any savings.

CHAPTER II.

The Deota Sledge Road.

Preliminary considerations.—Up to the end of 1882-83, or as long as the fellings at Deota were located to the east of the Bagiár stream and the Jaurási Dhár, no general line of export to the head of the slide could be followed, nor would the ground admit of any suitable system of tramway or sledge road being constructed. After, however, the fellings passed in 1883-84 to the west of the Jaurási Dhár, it became evident that a large portion of the timber from the Jaurási, Kanga, and Patangni blocks (*see* hatched portions in the accompanying Map of the Deota forest) would practically follow one line of export: so that some mechanical means of transport would, therefore, be advantageous. Various suggestions were made and considered,

and it was at last decided that a 'sledge' road—"Chemin de Schlittage" of the French Forest Department—would probably be the best system to adopt.

As no road of this kind has ever been previously constructed in India, as far as I am aware, and as its working depends to a certain extent on uncertain elements, such as co-efficients of friction, state of the weather, temperament of the workmen available for sledging, &c., great difficulty was experienced in deciding upon the gradient of the roadway, the kind of sledge to employ, best line to adopt, and other matters.

Towards the end of 1882 therefore, a short length of about 1,000 feet of experimental sledge road was constructed along an old path, apparently intended by Mr. Greig for a wheeled tramway, which was not, however, constructed.

On its completion I directed Mr. Hobart-Hampden to lay out a trial line, with a gradient varying from 5 to 10 degrees, from a point situated as near as possible to the middle of the forest about to be worked to a point on the Jaurási Dhár, immediately above the head of the timber slide (*see* accompanying Map of the Deota forest).

The experimental length of sledge road was completed in the spring of 1883, and was carefully examined by Major Bailey, the Conservator of Forests, and with his approval the construction of about 1½ miles of sledge road was decided upon.

At Major Bailey's suggestion, however, alternative lines were tried, but all were found to be less practicable and more costly than the one already laid out, and that line, with a few slight alterations, was, therefore, finally adopted.

The line of sledge road is probably the best available, and taps a large area of unworked forest, it being, perhaps, unnecessary to remark that the construction of the sledge road in a straight line from the middle of the forest to the head of the slide is impossible, owing to intervening ravines and precipices. The distance from the lower sledge depôt to the head of the slide, per carrying path, is 5,760 feet, and the vertical difference of altitude 2,000 feet.

An extension of the sledge road at the upper end was considered undesirable on account of the nature of the ground; and it has not been continued to the head of the slide for reasons given in the last paragraph of this report.

Amount of timber available from the forest tapped by the sledge road.—Before the construction of the sledge road was finally decided upon, the question of the quantity of timber likely to be brought down was carefully considered, for on this data, of course, depend the probable financial results of the undertaking.

The following estimate is based on the valuation survey carried out during 1878-79 and already referred to. It should be here noted that this valuation survey gives the total number of green trees in the forest, whether fellable or not; but in the

Dhopta and Katatách blocks, where the first fellings have just been completed, it has been found that only about one-third of the trees enumerated by the valuation survey party are available for felling.

This is due to the precipitous nature of the ground and to there being a number of branchy trees which are not worth felling; so that in the following calculations only one-third of the trees given by the valuation survey has been taken in calculating the quantity of timber likely to be exported along the sledge road.

The results arrived at are as follows, the area referred to being represented by the hatched portions on the accompanying general Map of the Deota forest:—

Name of block.	No. of trees given by the valuation survey on area tapped by the sledge road.	No. of trees available for felling.
Jaurási, ...	6,300	2,100
Kanga, ...	3,220	1,070
Patangni, ...	6,090	2,030
Total, ...	15,610	5,200

The outturn in metre gauge sleepers will probably be as follows, allowing an average of 50 metre gauge sleepers per tree:—

5,200 green deodar trees at 50 metre gauge sleepers per tree, ...	2,60,000
Add probable amount of timber obtainable from 700 dry and fallen trees at 40 metre gauge sleepers per tree, ...	28,000
Total sleepers, ...	2,88,000

Out of this total number it is estimated that about 2,08,000 sleepers will be transported along the whole length of sledge road [*see* area marked (A) and vertical hatching on the accompanying Map], whereas the remaining 80,000 sleepers will only be carried along half of the length of the sledge road [*see* area marked (B) and horizontal hatching on the Map].

Construction of the sledge road at Deota.—The construction of the sledge road was commenced in June 1883, and as no contractor would undertake the job at reasonable rates, owing to the apparent difficulty of the ground and of the novelty of the undertaking, the main portion of the work, *viz.*, the preparation of the roadway and the construction of the bridges, had to be done almost entirely by daily labour.

The sledge road was completed about the end of July 1884, and was opened for through sledge traffic on the 1st of August; and the execution of this somewhat arduous task has been principally done under the direct supervision of Mr. Hobart-Hampden, Assistant Conservator; the gangs of workmen having been in charge from time to time of Rama Dat and Birkodhar, Foresters, and Bhajan Singh, Forest guard, all of whom have shown considerable practical intelligence in carrying out the work.

The first operation was the preparation of the roadway, which is 6 feet wide and passes in some places through some awkward precipices of hard quartzite rock.

The total length of the roadway is 5,877 feet, including 20 bridges, aggregating 1,068 feet in length.

The amount of hard rock cutting requiring blasting is about 14,000 cubic feet; the number of blasts having been 1,500, and the quantity of powder expended about 400 lbs.

There are nearly 7,500 cubic feet of retaining walls, also one or two considerable cuttings.

The gradient of the roadway varies from 5 to 11 degrees, the average being 8 degrees, and experience has shown that the best gradient is from 7 to 8 degrees; but owing to the nature of the ground it was, of course, found impossible to give the roadway one continuous gradient.

Numerous curves also could not be avoided, and some of them are extremely sharp, having a radius of from 20 to 22 feet only; but round these the sledges are found to run without any difficulty.

Commodious depôts have been constructed at the head and foot of the sledge road for the stacking of the sleepers when brought from the forest, and on their arrival at the lower depôt, as coolies are not always available for the immediate carriage of the sleepers to the head of the slide.

The upper sledge road depôt, which is situated on a cliff overhanging the Jaurási water-fall, has an elevation of 7,555 feet, whilst the lower depôt is at an altitude of 6,720 feet: so that the total fall of the sledge road is 835 feet, the heights having been ascertained by means of an aneroid barometer.

Bridges on the sledge road.—As already explained, the nature of the ground is such that many ravines had to be crossed: so that in all 20 bridges and wooden viaducts have been constructed, the total length of which is, as already stated, 1,068 feet.

The most important of the bridges constructed is bridge No. 10 (*see* accompanying Plate), which spans a dry ravine at about one-third of the distance from the upper depôt.

The total length of this bridge is 107 feet, and its building presented considerable difficulty owing to the rough nature of the ground and the size and weight of the timber which had to be dealt with.

However, Mr. P. Mackenzie, Executive Engineer, visited the sledge road in May 1884, and kindly gave us the benefit of his advice and assistance in calculating the proper dimensions to give to the timbers, strains to be allowed for, &c. These calculations show that the bridge is capable of carrying at least five times the burden of a loaded sledge and two men, the weight of which does not exceed 23 maunds.

The middle span of this bridge is 48 feet long, and the two side spans respectively 33 and 17½ feet. There are two main piers, 29½ and 27½ feet high, which are built of rubble masonry, bound together with heavy beams of deodar and kail timber, the tops of the piers consisting of timber cribs constructed of rejected deodar sleepers.

The gradient of the bridge varies from 5¾ to 7 degrees, and the whole of the wood-work of the superstructure consists of deodar timber, rejected sleepers having been principally employed.

Another important bridge is No. 18, the peculiarity of which is that it is supported on two beams placed in the form of a St. Andrew's cross, the horizontal beam on which the bridge rests being firmly fixed into the neighbouring cliff by means of an iron crow-bar (*see* Plate). This bridge has a gradient of 9½ degrees, and the roadway at the same time passes round a slight curve—two circumstances which render it a somewhat difficult bridge for sliding.

A large number of rejected sleepers being available from the neighbouring forests, a very convenient system of crossing shallow ravines has been adopted, *viz.*, by means of sleeper viaducts (*see* accompanying Plate). Four of these have been constructed on the sledge road; the average cost, including the roadway, having been only from 3 to 4 annas per running foot.

System of roadway adopted and construction of the same.—The whole of the timber with which the roadway is laid consists of rejected deodar sleepers, and is constructed in the following manner (exhibited in the accompanying Plate):—Two lines of metre gauge sleepers are first laid down longitudinally, 2 feet 9 inches apart, the ends being jointed and firmly fixed by means of moru (*Quercus dilatata*) pegs; across these, at distances of 2 feet 6 inches apart, the transverse sleepers are placed, and these are either jointed or pegged to the lower sleepers by means of moru pegs, but on bridges and sharp curves 6-inch nails are used. In this manner the whole wood-work of the sledge road is firmly tied together.

Across the upper sleepers, the grooves, in which the sledges run, are cut, situated 2 feet apart, and having breadths varying from 4 to 6 inches, according to the curves, their depths being from half to three-quarters of an inch.

The central portion of the roadway between the longitudinal sleepers is ballasted with the best available materials up to a

level with the transverse sleepers; this arrangement preventing the roadway from shifting, and at the same time forming a convenient path for the sledge men.

It may be here mentioned that on the experimental length at first constructed, and on the lower section of the new road, the system employed in the Vosges Mountains—*viz.*, of laying the transverse sleepers singly on the ground 2½ feet apart and fixing them by means of pegs driven into the ground and ballasted up—was tried.

This plan was, however, soon abandoned, as the sleepers rapidly got knocked out of position by the jolting of the sledges: so that the more expensive but much more substantial system now adopted was resorted to and has proved durable and convenient.

On the outside of sharp curves, guards consisting of half metre gauge sleepers are fixed, and effectually prevent the sledges from running off the line in such places.

Owing to the steep nature of the hill-sides, a careful system of drainage is necessary; and the inner side of the roadway generally consists of a deep drain, the rain water being let out across the roadway by a system of 31 wooden troughs.

It is estimated that the whole of the wood-work of the sledge road will last at least five years, by which time the works at Deota will probably be closed.

Cost of the sledge road.—Notwithstanding the fact that the sledge road is a novelty and was principally constructed by daily labour, the cost, including powder and ten sledges, only amounted to Rs. 3,587.

It may be here noted, by way of comparison, that the Mandhól tramway, the length of which is about the same as the Deota sledge road, and which runs along a plateau covered by old fields, together with the trucks used for conveying sleepers, apparently cost Rs. 4,894; but in those days labour and food was, of course, even more expensive than it is now.

Sledges used on the sledge road.—The proper kind of sledge to employ has been one of the most difficult problems to be dealt with in introducing this system of transport into the Himálayas, and even the sledges now in use (*see* accompanying Plate) are not all that could be desired.

Various kinds of sledges were tried and found unsuitable, the difficulty being to combine lightness with strength; the average load to be transported, about 16 maunds, necessitating a strong and substantial sledge, and one at the same time not heavier than two men could conveniently carry up again to the head of the sledge road.

After various experiments and failures, the best kind of sledge yet constructed consists of two strong wooden runners placed 2 feet 2 inches apart, into which the uprights forming the front part of the sledge are firmly fixed.

The front uprights against which the sleepers rest are bolted together by means of two or three light bolts, and all the joints are firmly secured by means of iron plates and rivets.

The runners are, of course, the weakest part of the sledge, and it was found that they soon wore away by friction and generally gave way after about a month's running.

The plan of using a sole was then adopted by Mr. Hobart-Hampden, and has, as a rule, answered well; though there is still some difficulty in fixing the soles to the runners, as the screws are liable to snap. The latest plan adopted, therefore, is to make the runners about 5 inches deep instead of 3½ inches as at first, and to run these without soles till about 1½ inches of the wood is worn away, when soles are applied. After various experiments, it was found that moru oak is the best kind of wood to use for the runners and soles; shisham not being strong enough for this purpose, though it is found suitable for the upper portion of the sledges, as it has the advantage of being lighter than the moru.

The length of the sledges is 8½ feet, the width 2 feet 7 inches outside measurement, and the height 3 feet 9 inches, and it is perhaps unnecessary to remark that only the best seasoned timber should be used—especially for the runners and soles. The sledges are constructed to hold 20 metre gauge sleepers, which are packed longitudinally, as represented in the Plate, and the two back uprights are joined above the sleepers by means of an iron hook, which is removed when the sledges are being loaded or unloaded.

It should also be noted that, as the sledges always move downwards, the sleepers rest against the front and cannot fall out behind.

Working of sledge road.—The sledges are worked by two men; it being the principal duty of the man in front to guide the sledge into the grooves, also to pull or restrain the sledge according to the gradient; whilst the man behind moderates the pace of the sledge by means of a rope attached to two iron rings, or pushes it forward as necessity arises.

At first, the sledge men, after reaching the lower depôt and depositing their freight, dragged the sledges up again along the road; but this plan was soon given up for the easier one of carrying the sledges upon their shoulders.

As already explained, the roadway has been constructed with gradients varying from 5 to 11 degrees; and on the former gradient it is found that the sledges do not run easily, whilst on the latter they are inclined to break away from control. However, the application of *ghi* in the former case, and of sand in the latter, remedies to a certain extent those defects, and two chaukidárs are kept on the road during the sledging to regulate these matters and otherwise assist the sledge men.

Many suggestions for breaks or drags have been made, but no very practical arrangement has yet been arrived at.

Some difficulty was at first experienced in getting the hillmen to take to this new system of transport, and one man was unfortunately killed, before the roadway was quite completed, by a loaded sledge dragging him over a precipice.

All the more dangerous places were then carefully fenced in, and this has had a re-assuring effect on the men and renders the re-occurrence of such an accident impossible.

After a few weeks of careful training the men soon got fairly expert at the work, so that now, when a sledge breaks away from control, the front man generally jumps out of its way and holds on to the rope behind, and thus assisted by the friction of the sand, he soon brings the sledge to a standstill.

The effect of very wet weather on the sledging is that there is considerable difficulty in starting the sledges even on steep gradients; but when once started they tend to bolt, so that at such times sledging is either altogether prohibited, or permitted on the condition that three men—two behind and one before—take charge of the sledges. At the commencement of the work the sledge men with difficulty made from two to three journeys per day; but now, when the weather is favourable, some of the more expert workmen make from five to six runs per day, representing a distance travelled over of between 13 and 14 miles.

The number of sleepers carried in a day by two men varies, therefore, from 100 to 120, whilst 24 is about the maximum number the same two men could carry on their backs over the same distance.

At first, sledging through a contractor at 4 pies per sleeper was tried; but this was soon given up for various reasons, and a system of passes substituted, which has been found to work well.

A ticket is now issued for each loaded sledge that leaves the upper depôt, and is checked on arrival at the lower end of the sledge road; the sledge men retaining the passes, which they present for payment at the office.

The present rate for sledging is 3 pies per sleeper; whereas the rate paid for carriage on coolies' backs over the same section before the construction of this sledge road was completed was 1 anna.

The total saving in carriage effected by the use of the sledge road during the first year's working was Rs. 1,900.

Financial results of the sledge road.—The following is a statement of the probable financial results of the sledge road, it being estimated, as already explained on page 374, that probably 2,08,000 metre gauge sleepers will be transported along the whole length of the sledge road, and 80,000 along about half the length.

It is also estimated that the working out 2,88,000 metre gauge sleepers at the rate of 50,000 per annum will be distributed over a period of about five years, as the fellings at Deota are at present limited to 1,000 deodar trees per annum.

The estimate may be represented thus :—

	Rs.	
Carriage of 2,08,000 metre gauge sleepers over the whole length of the sledge road by means of sledges *versus* coolie labour, at 8 pies per sleeper instead of at 1 anna (*i. e*, at a saving of 9 pies per sleeper) : 2,08,000 at 9 pies, ...	9,750	
Carriage of 80,000 metre gauge sleepers over half the length of the sledge road by means of sledges *versus* coolie carriage, at 1½ pies instead of at 6 pies (*i. e.*, at a saving of 4½ pies per sleeper) equal to 80,000 metre gauge at 4½ pies, ...	1,875	
Total actual saving, ...		11,625

The ultimate financial result will, therefore, probably stand thus :—

	Rs.	
Original cost of the sledge road, ...	3,587	
Probable cost of repairs for five years, at Rs. 200 per annum, ...	1,000	
Cost of 10 new sledges per annum, at Rs 50 each,	500	
Pay of two chaukidárs during the working season for six months each, and other expenses, ...	938	
Total expenses, ...		6,025
Net anticipated savings due to the sledge road, ...		5,600

It is perhaps unnecessary to remark that if it had been found practicable to make the sledge road longer, the financial result would be greater, as its present length approaches a limit under which it would not, of course, pay at all.

CHAPTER III.

General Remarks.

Comparison of the sledge road with the wheeled tramway system.—A few remarks by way of comparison between the sledge road and wheeled tramway system of transport may be of advantage for future guidance of such works in the hill forests.

In the *first* place, the great difference of the system is that a sledge road can be constructed on a roadway having a gradient about twice as steep as that of a wheeled tramway, unless the latter is furnished with an elaborate system of cog-wheels, which arrangement is, of course, too expensive for forest purposes.

2nd.—As far as I am aware, the sledge can be made to run round much sharper curves than four-wheeled trucks, even though the latter are provided with bogie-wheels.

3rd.—The sledges cost much less than the tramway trucks, and can be made by any ordinary carpenter.

4th.—The cost of constructing a sledge road is probably much less than the cost of making a wheeled tramway;—at least such has been the result in comparing the cost of the Deota sledge road with the expenditure on the neighbouring Mandhól and Lambatách tramways.

Saving of labour effected by the use of mechanical means.—The advantages of the substitution of mechanical means of transport for coolie carriage in hill forests, where the use of draught animals is impossible and labour is scarce, are immense from various points of view; and it may be mentioned that last season at Deota, owing to a cholera scare, constant rain, demand for labour on other works in the neighbourhood, &c., the Government sleepers could not probably have been got down in time for floating had the sledge road not been working.

Proposals to connect the lower sledge depôt with the head of the slide.—A glance at the accompanying plan of the Deota forest shows that it would be highly desirable to connect the lower end of the sledge road with the head of the timber slide; which arrangement would, of course, do away with the awkward break and complete the line of transport of the timber by mechanical means.

The difficulties to be dealt with in connecting these two points are, however, considerable: the ground being extremely precipitous, the distance in a straight line at least 3,000 feet, and the vertical difference in altitude of the two points 2,000 feet. Many plans have been thought of and considered, which may be enumerated as follows:—

1st.—To construct a dry timber slide or shoot connecting the two points, such as was constructed on the bank of the Tons river below Mandhól, also for a portion of the length of the Lambatách slide. The successful working of such a slide, however, depends on its being constructed in a comparatively straight line, and with nearly one ruling gradient, whilst the nature of the ground at Deota is such at the place referred to that the construction of such a slide is practically impossible.

2nd.—A system of wire-tramway, something after the style of the Pind Dádan Khán line, has been thought of, and Dr. Warth was deputed to construct an experimental length of about 300 feet at the head of the slide. The result was not, however, encouraging, so that this plan was abandoned.

3rd.—The question has been considered whether the sledge road could not be run down to the head of the slide by means of a system of turn-tables or reversing stations.

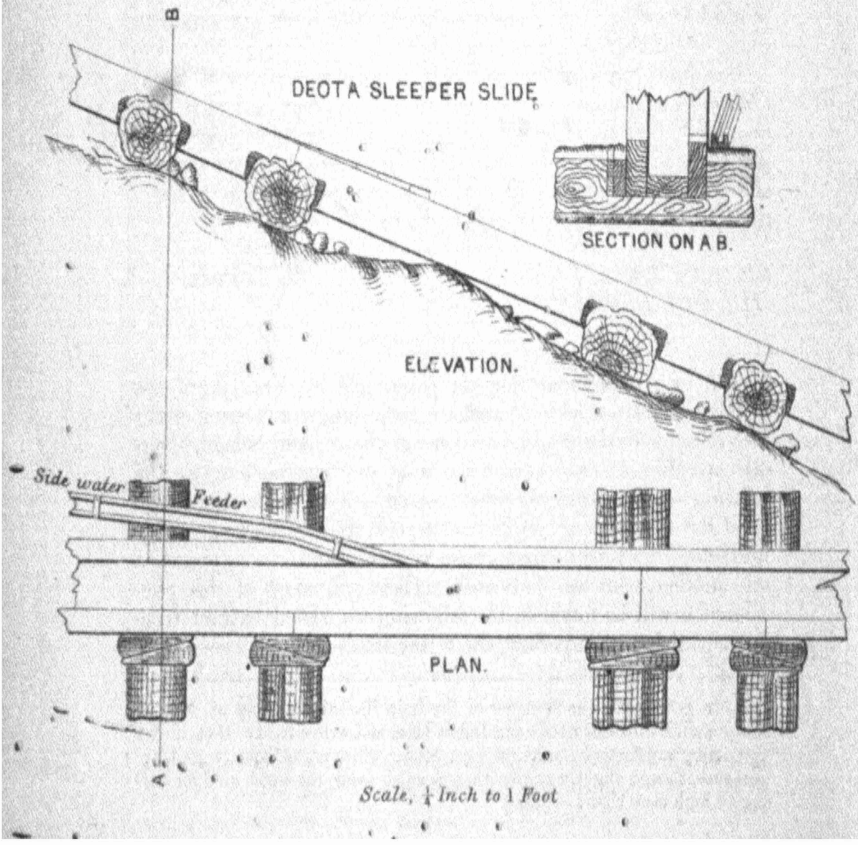
As the difference of elevation of the two points is 2,000 feet, a simple calculation shows that to make that descent with a mean gradient of 8 degrees (equal to about 15 feet in the 100), the length of roadway necessary would be over 13,000 feet, or about $2\frac{1}{2}$ times the length of the present sledge road.

The nature of the ground also, as already explained, is most awkward; and as the path by which the coolies carry the sleepers at present is only 5,760 feet long, it is obvious that a sledge road on this section could not compete with manual labour, and would not therefore pay.

E. McA. Moir,
Deputy Conservator of Forests,
Jaunsár Division.

5th September, 1885.

Note.—The following drawing, by Mr. T. Marten of the Forest Survey, represents the system followed in the Deota slide.—[Ed.]



IV. Notes, Queries and Extracts.

WOOD FOR CIGAR BOXES, &c.

With regard to the query above, and the reply of ex-Student in June number, I should say there can be little doubt that one of the best woods, or even the very best of all, is Poma (*Cedrela Toona*). It has all the qualities needed, *i.e.*, color, lightness, durability and ease in working. There are many good woods, but their color, or rather want of color, is against them.

The Poma or cedar-like tún has all the qualities required in a very high degree. It is a real wonder that this most useful of all our trees in India is not *extensively* planted, *i.e.*, that large areas are not devoted to it alone in all provinces. It grows remarkably easily, and seeds profusely; the seeds germinate at once, and it also bears transplanting.

I cannot bear out ex-Student's recommendation of Sum, (*Machilus odoratissima*). I have worked a great deal of it, *i.e.*, about 800,000 superficial feet, during the last three years. It is heavy and rather cross-grained, besides being the tree on which silk-worms are reared. The wood of woods for cigar boxes is undoubtedly Poma, or the cedar-like tún.*

Sibsagar, Assam,
11th July, 1886.

S. E. Peal.

It will be remembered that on pages 155-58, Vol. IX. of the "Indian Forester," Dr. Warth, in publishing a summary of the meteorological observations taken at the Forest School, drew our attention to the very interesting fact that as long as the minima temperatures observed respectively at the low and high level stations were appreciably different, fair weather was prognosticated, and that when these two temperatures approached one another, rain was indicated. The explanation of this phenomenon will be found in the following translated extract from our Spanish contemporary, the "Revista de Montes":—

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* Mr. Sutherland, the Manager of the Indo-Havana Company of Meerut, was supplied with tún wood from Dehra Dun, and writes to say that it has given very satisfactory results for cigar boxes, which are of equally good appearance, though slightly costlier than Spanish cedar, the wood used for boxing all high class cigars.—[Ed.]

"Continuing his observations regarding all that relates to the phenomena of heat, Dr. Tyndall compared the readings at the same hour of the night of two differently placed thermometers. One thermometer was suspended in the air at 4 feet above the ground, while the other rested on a cotton pad placed on soil cleared of all vegetation. The experiment was carried on away from buildings, and from whatever was likely to interfere, however so little, with free radiation.

"Under these conditions the thermometer on the ground indicated a lower temperature than the other, and the difference between the two readings varied from 4° to 18° Fah. While the moist south-west wind was blowing, or immediately after heavy rain had fallen, the difference was always slight, and even under an absolutely clear sky, which ought to have favoured radiation, the difference did not exceed 6° or 7°.

"On the other hand if the observations were taken during the prevalence of dry winds from the north and north-east, the difference was much more considerable, a circumstance that proved a much more active radiation than before.

"The conclusion to be drawn from these observations is apparently that the watery vapour suspended in the atmosphere, without interfering with its diaphaneity, acts as a sort of medium which impedes the passage of heat and retards the cooling of the ground by radiation."

NEW TANNING MATERIALS.—We have been favoured with a new extract—that of "sal" bark—forwarded to us by the Conservator of Forests in Oudh, India. There are large forests mainly composed of these trees in certain districts in India, so that the supply may be said to be inexhaustible. Its value as a tanning agent has, however, to be tested in the tannery.

Copy of Analysis. Extract of "Sal" Bark.

Specific Gravity 1 333 = 36 degrees Baume.

Moisture, ...	32·41	per cent.
Reduced to ashes, ...	68·56	„
Tannic Acid, ...	32 29	„
Non-Tannin, ...	3·93	„

The colour of the solution is a brownish red, and from its reactions we should not judge it to be a weight-giving material.—*Leather.*

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INDIAN FORESTER.

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FOREST ORGANIZATION FOR BEGINNERS.

(*Continued from page 348*).

CHAPTER VI.

DETERMINATION OF THE YIELD OF FORESTS REGENERATED BY THE METHOD OF REGULAR CUTTINGS—(*concluded*).

4.—THE COMBINED METHOD.

WHILE the methods of area demand that almost exclusive attention be paid to a regularization of the age-classes, and Hartig would sacrifice all other considerations for the sake of uniform annual yields during the revolution, the main object of that form of the combined method, which is now generally adopted, is to steer a middle-course between these two extremes : to pay proper attention to the ultimate attainment of a satisfactory state of age-classes and sequences, without unduly favouring future, at the cost of present, generations.

When, two or three centuries ago, the forests of Europe were thought to be disappearing, and some sort of system in exploitation came to be regarded as essential to save them from devastation, all that at that time was deemed necessary in the matter of organization was the establishment of a sustained yield with the least possible delay. The shortest road to this end was considered to be the division of the forest into a number of coupes equal to the number of years in the revolution, and the cutting over of one each year. But in seedling-forests, as already explained, simple methods of area, besides presenting other drawbacks, do not necessarily lead to a sustained yield. Later on the method of proportional coupes was introduced, and, towards the end of last century, Hartig's method, either of which, provided the data on which the estimate rests be correct, and that nothing unforeseen arises to disturb the plan, certainly would afford what practically amounts to equal annual yields by the end of one

revolution. In the mean time, however, forests had been steadily increasing in value, and, since the beginning of this century, the idea has gradually gained ground that a sustained yield, however much to be desired, may be too dearly bought, and that, even from a politico-economical point of view, it may be more advantageous to exploit groups at the most useful period of their existence than to attain uniform periodic yields, or an ideal state of age-classes, by sacrificing young groups, or by holding over mature groups long after their proper term. The futility of attempting to determine the increment for long terms, as well as the exact time of exploitation of every group to the remotest period, no doubt contributed considerably towards this more rational view of the matter. At the present day, therefore, the most eminent authorities have completely abandoned the notion that a regularization of age-classes, or a sustained yield, is the only object to be considered in organizing a forest, and hold that, for all practical purposes, it should suffice to determine the yield of the first period only, which should be fixed after duly weighing all considerations of sylviculture and economy.

There are many varieties of the combined method, but all have this characteristic, that the periodic yield is fixed by area, while the annual yield during a period is determined from an estimate of the average annual yield of the standing-stock appertaining to such period. One form demands equal affectations: in another, the chief object is to attain equal periodic yields, at the cost of more or less unequal periodic areas: a third insists on the continuity of each periodic area, while a fourth affords full scope for the selection of groups of an affectation from the whole series. Some, again, require an estimate of yield for the whole revolution; others, only that of the first 10—20 years.

The combined method having been evolved from the two methods last described, the oldest form is naturally that which requires the estimate of yield for the whole revolution. Owing, however, in a great measure, to the difficulty of determining prospective yield for a long term of years, the calculation in recent times has, as already observed, been generally confined to an estimate of the yield of the first period.* There is certainly no harm in attempting to estimate the yields of all affectations, but experience teaches that such estimates are sure to be upset, and that it is quite impossible to place any reliance on forecasts for more than a comparatively short space of time. When, therefore, an estimate is made for the whole revolution, the estimated yields and proposed distribution of groups of later

* Perhaps this statement is too sweeping. It appears that the older system is still very general in France. In Germany, it has long been abandoned for the reason given in the text, and because an equalization of the yields of periods, which is the sole *raison d'être* of the method, is no longer considered essential to a good scheme of exploitation.

periods can only serve to give a rough idea of the probable returns and course of events.

For the purpose of illustrating this method, we will take the forest described at page 339, (August Number.)

The area of the series being 540 acres and the revolution 60 years, the normal coupe would be $540 \div 60 = 9$ acres; and each normal periodic area (the forest being of uniform fertility throughout) would be $9 \times 20 = 180$ acres, for periods of 20 years.

The following table shows the normal and actual states of the age-classes which proceed by differences of 20 years :—

Age-class.	Area occupied by each age-class.			
	Normal	Actual.	Too much.	Too little
1—20, I, ...	180	192	12	...
21—40, II, ...	180	159	...	21
41—60, III, ...	180	189	9	...

A blank of 13 acres is included in the first class. There is a large stock of over-mature wood: 54 acres of groups 80 years old, and 71 acres of groups 65 years old, together 125 acres. The remaining groups, which would naturally be cut during the first period, with the exception of 4*b* of 14 acres, stocked with a group 55 years old, would all have to be exploited at an average age of 55 if the normal periodic area is worked out during the first period. The quality of the groups is uniform, and they are of uniform density throughout, so that the proportion of inferior and superior groups in the several age-classes has not to be considered in this case. The old groups in 1*a*, 2*c* and 6*b* are long past their proper term, and it is desirable that they should be replaced by young growth with the least possible delay. This is all the more necessary, as it is to be feared that they will soon become unsuitable for natural reproduction by seed, which is the mode of regeneration that it is desired to apply to them. On the other hand, there is a rather serious deficiency in the second age-class, which would, in itself, render the husbanding of the resources of the first desirable. The produce is chiefly exported, and there is no fear of injuriously affecting prices by cutting considerably more than the normal yield during the first period. All things considered, the organizer thinks it advisable to put about the normal area into the first affectation, but to split it up into two portions for the purpose of calculating the yield, so as to enable the manager to hasten the cutting of very old groups, and to retard cut-

tings during the latter part of the period. In pursuance of this plan, it is proposed to cut annually for the first ten years 3,200 cubic yards, in round numbers; but, during the second half of the period, only 2,850 cubic yards. This estimate is arrived at as follows:—

1st Decade.

Compartment.	Area, acres.	Present age of group.	Average age of exploitation.	Yield per acre, cubic yards.	Yield of group, cubic yards.
1*a*, ...	30	80	85	385	11,550
2*c*, ...	10	80	85	385	3,850
6*b*, ...	14	80	85	385	5,390
2*d*, ...	15	63	70	321	4,815
3*a* (part), ...	21	65	70	321	6,741
Total, ...	90	...	...	...	32,346
				Mean yearly yield, ...	3,235

2nd Decade.

Compartment.	Area, acres.	Present age of group.	Average age of exploitation.	Yield per acre, cubic yards.	Yield of group, cubic yards.
3*a* (remainder),	35	65	80	364	12,740
4*a*, ...	43	45	60	276	11,868
4*b*, ...	12	55	70	321	3,852
Total, ...	90	...	...	...	28,460
				Mean yearly yield, ...	2,846

The above arrangement gives 180 acres for the whole period, which is the normal area of the affectation. That the groups chosen for cutting are suitable has been shown in the previous example, (*see* page 339, August Number.)

To enter upon further calculations with a view to fixing the yield of the next period, or next two periods, would be quite superfluous. A glance at the age-classes at once shows that ample provision has been made for the future, and that it will be quite soon enough if the calculation be continued at the end of the first period, when the organizer will be in a much better position to estimate the yield of the second period. If, however,

it is desired to obtain a rough idea of the probable plan of exploitation during the next two periods, the following provisional allotment of groups might be made, when, if the increment remained the same, the yields shown below would result. It is unnecessary to say, after what has been already said, that the calculation of the yield of the second and third period is unnecessary.

2nd Period.

Compartment.	Area, acres.	Present age of group.	Average age of exploitation.	Yield per acre, c. yards.	Total yield of group, c. yards.	Remarks.
4*b* (remainder),	2	75	85	385	770	
3*c* (part), ...	2	25	35	120	240	3*c*, safety cutting.
3*d*, ...	7	65	75	343	2,401	
1*c*, ...	12	35	45	204	2,448	
2*a*, ...	45	50	60	276	12,420	
5*b*, ...	30	50	60	276	8,280	
4*d*, ...	14	50	60	276	3,864	
3*b*, ...	8	50	60	276	2,208	
1*b*, ...	20	41	51	229	4,580	
2*b*, ...	31	35	45	204	6,324	
6*a* (part), ...	9	41	51	229	2,061	
Total, ...	180	...	...	...	45,596	
			Mean yearly yield, ...		2,280	

3rd Period.

Compartment.	Area, acres.	Present age of group.	Average age of exploitation.	Yield per acre, c. yards	Total yield of group, c. yards.	Remarks.
6*a* (remainder),	33	61	71	326	10,758	6*b*, second time of cutting during revolution.
3*c* (remainder),	35	45	55	276	8,820	
5*c*, ...	11	40	50	225	2,475	
6*b*, ...	14	30	40	158	2,212	
5*d*, ...	13	45	55	252	3,276	
5*a*, ...	55	50	60	276	15,180	
4*c* (part), ...	19	50	60	276	5,244	
Total, ...	180	...	...	...	47,965	
			Mean yearly yield, ...		2,398	

The station being of uniform quality throughout, the annual yield of the ideal state would be $9 \times 276 = 2{,}484$ cubic yards, (9 acres being the normal annual coupe, and 276 cubic yards the yield per acre of a group 60 years old,) and, if things turned out as anticipated, the actual yield would be fairly normal during the third period, and not very far off normality during the second.

The estimate of yield for the first period does not include yields from thinnings and minor produce. The average annual yield, if any, from these sources would have to be added in order to give the full return.

The yield from thinnings may be taken as equal to the average annual yield of the last five years, or it may be estimated after a careful examination of the groups to be thinned during the period, or at so and so much per cent. of the main yield, or from experiential tables. Minor produce (stones, fruit, sap, earth, honey, &c.) may be estimated on the average return of the last five years.

The advantages of the combined method are, as regards seedling-forest, that the affectations being fixed by area, excessive or insufficient cuttings are easily guarded against, and that certain provision can be made for future periods; at the same time, uniform annual yields are obtained during each period, and the manager is afforded ample scope for the exercise of judgment in the selection of groups for regeneration. Due attention can also be paid to the economical side of the question, which is not possible by those methods, previously described, which are based on a fixed idea to which all other considerations must give way.

CHAPTER VII.

DETERMINATION OF THE YIELD OF OVERWOOD AND OF SERIES SUBJECT TO THE METHOD OF SELECTION.

1.—OVERWOOD-SERIES.

Here two distinct modes of treatment are necessary, one for the overwood, the other for the underwood.

The underwood may be most conveniently treated by the method of equal areas, or of areas inversely proportional to their supposed productive power. The former will generally be found sufficient for all practical purposes.

The overwood may be regarded as open seedling-forest without reference to the underwood. It is convenient, and usual, to choose a revolution for the overwood which is a multiple of that of the underwood, so that if r represents the revolution of the underwood, mr may represent that of the overwood; in that case, if the revolution of the coppice were 30 years, and that of the standards 90, m would be equal to 3.

For the underwood in an ideal forest, the area of the annual coupe is equal to $\frac{A}{r}$, when A represents the area of the forest. The area occupied by one age-class of the coppice is equal to $n\frac{A}{r}$, when n represents the number of years in each such class; but the area occupied by each age-class of the overwood can not be determined in a practical way, because a confused mass of trees of various ages occur on each coupe of the underwood. In the ideal forest, however, we may, for the sake of clearness, picture to ourselves each class separated from the mass and occupying a compact area by itself, in which case there would be mr groups of standards in a regular series from 1 to mr years old, each occupying a space equal to $\frac{A}{mr}$. For, the oldest coupe of the underwood would contain standards of the following ages:—

	r,	$2r$,	$3r$,	. . . mr
The next in age of	$r-1$,	$2r-1$,	$3r-1$,	. . . $mr-1$
The third oldest of	$r-2$,	$2r-2$,	$3r-2$,	. . . $mr-2$

And so on, down to the last coupe of the underwood, with group $r - r = 0$ years old, which will contain standards—

$$r-r,\ 2r-r,\ 3r-r,\ \ldots\ldots mr-r, \text{ years old.}$$

that is to say

$$0,\ r,\ 2r,\ \ldots\ldots (m-1)\,r, \text{ years old.}$$

There would, therefore, be a complete series of standards of all ages from 1 to mr years old. If, now, we assume that each class occupies an equal area, as in the ideal forest it would do, and if the standards are regarded in the light of open forest occupying the whole of the area, one year's coupe will be $\frac{A}{mr}$ in size, and the area occupied by each age-class will be $n\frac{A}{mr}$.

For a forest 100 acres in extent, with a revolution for its coppice of ten years, and one of 40 for its standards, the yearly underwood coupe would be $\frac{100}{10} = 10$ acres.

The overwood-coupe would be $\frac{100}{40} = 2\frac{1}{2}$ acres.

If the age-classes are taken for periods of five years each, there would be—

Class I. Underwood (trees 1 to 5 years old) $\frac{5 \times 100}{10} = 50$ acres.
„ I. Overwood (1 to 5 years old) $\frac{5 \times 100}{40} = 12\frac{1}{2}$ „
„ II. Underwood (trees 6 to 10 years) $10 \times 5 = 50$ „
„ II. Overwood „ „ $2\frac{1}{2} \times 5 = 12\frac{1}{2}$ „

And so on, for remaining overwood-classes.

Four classes of the overwood occupy the same area as one of the underwood, so that by taking the area of the latter as the area of one age-class, there would be

I. Class.

Underwood—50 acres with trees 1-5 years old.
Overwood— „ „ 1-20 „

II. Class.

Underwood—50 acres with trees 6-10 years old.
Overwood— „ „ 21-40 „

The number of gradations of age in the overwood is generally taken as $\frac{mr}{r} - 1$, when mr is the revolution of the standards, r that of the coppice. The first class is then supposed to belong to the coppice, being of the same age as, and undistinguishable from, it.

For practical purposes what has to be decided is the number of trees, or their cubic contents, of each age-class of a series, to be permanently maintained. This cannot be ascertained accurately, but it is possible to obtain a more or less correct estimate which may serve as a guide. The first thing to determine is the area of the ideal annual coupe. This, as we have seen, is equal to $\frac{A}{mr}$. The degree of cover admissible has then to be decided. This depends on the species constituting the underwood and on those forming the overwood—whether the former are shade-enduring or light-demanding, and the latter densely-leaved or open-crowned—on the station, and the comparative demand for coppice and standards. The degree of cover chosen is expressed in decimals, full cover being equal to unity. The cover may be determined by measuring the area occupied by a number of trees of the mean age required, and striking an average. The area occupied by a tree is found by measuring the area enclosed by (imaginary) perpendicular lines dropped from the tips of the outermost branches. If s_1, s_2, s_3, &c., represent the surfaces taken up by test-trees of the 1st, 2nd, and 3rd classes, respectively, q the degree of cover decided on for the overwood, and $n \frac{A}{mr}$ the area of an age-class, the number of trees in each class will evidently be :—

Class I. $\frac{n \frac{A}{mr}}{s_1} \times q.$; Class II. $\frac{n \frac{A}{mr}}{s_2} \times q.$; Class III. $\frac{n \frac{A}{mr}}{s_3} \times q,$

and so on.

Supposing we have an ideal forest of overwood, 120 acres in extent, with a revolution of 60 years ; $q = \cdot 25$: age-classes proceeding by differences of 10 years : and that the following average values have been obtained of s_1, s_2, &c. :—

$s_1 = 3$ square yards ; $s_2 = 6$ square yards ; $s_3 = 10$ square yards.
$s_4 = 16$ square yards ; $s_5 = 25$ square yards ; $s_6 = 36$ square yards.

The yearly cutting will be $\frac{120}{60} = 2$ acres $= 9{,}680$ square yards.

Each class will occupy 20 acres. The number of trees in each class will be as follows :—

Class I. (1 to 10 years old) $= 10 \times \frac{9680}{3} \times \cdot 25 = 8{,}067$

Class II. (11 to 20 years) $= 10 \times \frac{9680}{6} \times \cdot 25 = 4{,}034$

Class III. (21 to 30 years) $= 10 \times \frac{9680}{10} \times \cdot 25 = 2{,}420$

Class IV. (31 to 40 years) $= 10 \times \frac{9680}{16} \times \cdot 25 = 1{,}513$

Class V. (41 to 50 years) $= 10 \times \frac{9680}{25} \times \cdot 25 = 968$

Class VI. (51 to 60 years) $= 10 \times \frac{9680}{36} \times \cdot 25 = 672$

This represents the ideal quantity of standing-stock immediately before a cutting. On each coupe of the underwood there will be trees representing each age-class of the overwood, each class occupying an equal area. If, in the above example, the revolution of the underwood were ten years, its annual coupe would be $\frac{120}{10} = 12$ acres, and on the oldest, just before a cutting, there would be overwood 60, 50, 40, 30, 20, 10 years old. The next in order would have overwood 59, 49, 39, 29, 19, 9 years old, and so on in regular succession down to the youngest with overwood 50, 40, 30, 20, 10, 1 years old. Each underwood-coupe would have 807 first-class standards, 403 of the second, 242 of the third, 151 of the fourth, 97 of the fifth, and 67 of the sixth class. On the oldest coupe, for example, there would be 807 standards ten years old, 403 twenty, 242 thirty, 151 forty, 97 fifty, and 67 sixty years old ; the annual yield being 404 of the first class (virtually belonging to the coppice), 161 of the second, 91 of the third, 54 of the fourth, 30 of the fifth, and 67 of the sixth class.

The contents of the average tree for each class being known, it is, of course, easy to estimate the contents of the standing-stock of a normal series.

If, for instance, the test-trees in the above example contained on an average 0·02 cubic feet for Class I., 2·0 cubic feet for Class II., 7·2 cubic feet for Class III., 18·0 cubic feet for Class IV., 36·5 cubic feet for Class V., and 65·5 cubic feet for Class VI., the supply of overwood would amount to

$$8{,}067 \times \cdot 02 + 4{,}034 \times 2 \cdot 0 + 2{,}420 \times 7 \cdot 2 + 1{,}513 \times 18 \cdot 0 + 968 \times 36 \cdot 5 + 672 \times 65 \cdot 5$$

$$= 161 + 8{,}068 + 17{,}424 + 27{,}234 + 35{,}332 + 44{,}016$$

$$= 132{,}235 \text{ cubic feet.}$$

In this manner we may find the normal number of trees to be maintained, or established, and their ideal cubic contents. It is also necessary to know the heights, or diameters, of the test-trees of each class, in order that the height, or diameter, of a tree may be used to fix its age-class when working the forest.

If the yield is to be given in cubic feet, it is necessary to make a very careful and comprehensive estimate of the contents and increment of the overwood. The amount to be cut yearly in each class may then be fixed by the formula

$$Y = I + \frac{Q - Q'}{a}$$

when I represents the actual yearly increment of the series: Q the actual, Q′ the normal, supply: a the term of an age-class, which should correspond to the length of a period. If the forest is not normal as regards its age-classes, it must gradually become so, provided the estimate of increment and standing-stock be correct.

The data of this calculation are, however, very difficult to determine, and the usual, as well as safest and most simple plan, is to fix the number of trees of certain height- or diameter-classes to be cut annually, so that the uncertain elements, cover and increment, shall not be brought into the calculation, except as rough guides to the number of trees which should be maintained. The maintenance of a fixed quantity of overwood of each age-class is thus rendered a comparatively simple affair. If the age-classes are not normal, the object of the organization will be to make them so by suspending cuttings, or by reducing them below the normal rate until the desired object is attained.

The system of determining the number of trees of each age-class to be cut by a hard-and-fast rule is not likely to enable the proprietor to utilize his land to the greatest advantage. The number of standards of a given age which may be most advantageously maintained cannot be fixed arbitrarily without loss. All large areas consist of parts of various degrees of fertility, and the better stations will generally be capable of holding more overwood than the poorer ones. In one place it might, therefore, be to the owner's interest to grow more standards than the fixed number, in another less. Nevertheless, in extensive forests of this kind, order and regularity of yield may be of first-rate importance, and owners of large estates may sometimes prefer to sacrifice the chance of a certain amount of additional gain in order that the sustained yield of their forests may be practically secured by strictly prescribing the quantity of standing-stock to be maintained in each class.

2. Forest managed by the primitive method.

A normal forest worked on the primitive system is very similar to the overwood in stored coppice, only it is more densely stocked. If the revolution is fixed at 100 years, and there are 1,000 acres of forest, the yearly coupe will be equivalent to $\frac{1000}{100} = 10$ acres, and there will be a regular series of all ages from 1 to 100 years, occupying an area equal to 10 acres each.

But, unfortunately, in this case, as in that of the overwood of stored coppice, there are no means of knowing the area actually occupied by the oldest, or any other, age-class, because trees of all ages are mixed up together; and affectations, which are the best safeguards against excessive or insufficient cuttings, cannot, therefore, be constituted. The estimate of yield must, consequently, be based on mass and increment. But it is evidently practically impossible to estimate the number or quantity, let alone the growth, of the trees of the youngest age-classes, and it is, therefore, necessary to be contented with a much less thorough examination than is possible in the case of regular forest, or even stored coppice.

The best plan in regulating this kind of forest, is to confine the attention to a few of the oldest classes, and to estimate their contents and growth by measuring trees on test-areas, or on the whole forest-area if greater accuracy is required. If the revolution of a forest is about 100 years, an estimate of the standing-stock of the two oldest classes comprising, say, trees from 50—100 years old, will suffice for most practical purposes.

If the estimate is confined to test-areas, as will generally be the case, a long narrow form is the best to give them, as in very irregular forest that shape is most likely to give satisfactory results.*

Before measuring the trees, the first point to decide is, the size of the smallest tree, as indicated by its diameter at breast-height, to be taken into account. Supposing it were decided in a given case to begin at 18 inches' diameter, and to class together all trees of 18—20 inches, and again all those 20—22 inches in diameter, and so on, proceeding by differences of 2 inches for each class, and neglecting all trees under 18 inches. When the particulars of all measurable trees on the area taken up had been booked, representative trees of each class should be felled, and their heights, contents, ages, and increment determined, and finally the contents of each class calculated.

The quantity and rate of growth of each class would then be

* The following method of estimating the proportion of the standing-stock of different classes on test-areas in large forests was published some years ago, by M. de Béranger, in the *Tharandter Jahrbuch*. The working party consisted of two men with a surveyor's chain, two diameter-measurers, an ordinate-measurer, and a clerk. The chainers move in any required direction, measuring the linear distances travelled, zigzag or straight. The ordinate-measurer walks along the chain and swings to the right and left in advancing a staff 10 feet long, one end of which is kept vertically over the chain. The diameter-measurers measure and call out the diameters and species of all trees within the radius of the circle swept by the staff, and these diameters are noted in a field book by the clerk. The area examined, in square feet, will of course amount to $20 \times l$, if l represents the distance in feet travelled as measured by the chain, and practically insignificant differences owing to the lines not being straight, when such is the case, are neglected.

known, and it would be possible to calculate how long the oldest classes would have to last until the younger should become exploitable.

Supposing, for instance, that we find in a forest

Class I.	1,500	trees of	diameter	18–20 inches.
„ II.	1,500	„	„	20–22 „
„ III.	1,500	„	„	22–24 „
„ IV.	500	„	„	24–26 „

and that the most advantageous revolution is that which produces trees of about 23 inches diameter, we should have, according to the estimate, 1,500 exploitable trees, and if the average rate of growth in diameter of a tree of the class 20—22 inches is 1 inch in 10 years, it would take the 1,500 in that class 20 years to become exploitable, and we would have to husband the resources of the two oldest classes, so as to make them last that time. If, for example, the average tree of the penultimate diameter-class contained 120 cubic feet, and had an increment of 3 per cent., and that of the last contained 160, with an increment of 2·5 per cent., the material yield of the next 20 years would be—

	Cubic feet.
1,500 trees, with contents, ... 120 × 1,500 =	180,000
Add increment for 10 years at 3 per cent., =	54,000
500 trees, with contents, ... 160 × 500 =	80,000
Add increment at 2½ per cent. for 10 years, =	20,000
Total yield for the period, ...	334,000

The average annual yield for the period would be, $\frac{334000}{20} =$ 16,700 cubic feet; to which would have to be added the estimated returns from thinnings and windfalls, in order to obtain the total estimated yield.

This estimate of yield would, of course, require modification if there were found to be a considerable excess of old timber, or if the lower size-classes were insufficiently represented. During the examination of the forest the organizer would always obtain a rough idea of the relative proportion of the trees of inferior size-classes; but it is always within his power to include comparatively small trees in his examination if he should think such a step necessary.

A more simple plan, which is frequently resorted to, is to express the yield in trees. In that case the increment would have to be neglected. In the last example, for instance, there are 2,000 exploitable trees which would have to last 20 years, 100 might, therefore, be cut yearly with safety.

Even in forests organized in this rough-and-ready manner, it is advisable to have some sort of method in the working, and to decide, from period to period, which compartments are to be

exploited and how much produce is to be taken from each one. Each compartment should then be worked out in rotation, and given complete rest during the remainder of this period, so as to admit of its being properly protected during the years of reproduction. By this means, regeneration can be effected much more easily than when the cuttings are spread over the whole area, because, whenever wood-cutters, herdsmen and others are allowed the run of a considerable tract of forest, they cannot be properly supervised, and are apt to set fire to the jungle, or to allow their cattle to graze down the young growth. Naturally, too, re-stocking can be more carefully attended to when only a comparatively small area is taken in hand at a time. For these reasons, and in order to facilitate stock-taking and the removal of produce, compartments are just as necessary in forests managed by this method as by any other, although they may generally be made larger than in series subject to the methods of regular cuttings.

A serious objection to the selection-method is that it renders the regeneration of the forest difficult and hap-hazard; it is, moreover, a wasteful system, and one that does not admit of the sustained yield being determined with certainty. Notwithstanding these disadvantages, it is well suited to certain conditions, as, for instance, when forests, whose produce is of little value, can only be worked at a profit if treated very extensively. Again, to countries which are only just commencing to preserve their forests, it offers a simple, expeditious, and easily-understood means of regulating the yield, and of keeping cuttings sufficiently within bounds until such time as it may be possible to introduce superior methods. Sometimes, again, it is advisable to treat protective forests, by this method, in order to avoid the gaps which arise temporarily in the working of regular forests, and which might in some situations give rise to landslips, or endanger regeneration, or the safety of the surrounding crop.

(*To be continued*)

A CHAPTER ON SOILS—IN THEIR BEARING ON THE NATURAL REGENERATION OF SAL.

In wandering through the sál forests of Bahraich, we notice so many startling interruptions to otherwise vigorous forest growth, so many, at first, unaccountable differences in the vegetation covering confined tracts of country that, having also in view occasional strange anomalies between the character of the stock and that of the soil supporting it, we find ourselves forcibly attracted to a study of the latter subject.

Before making any special allusion to the character of the different soils met with in the Bahraich sál forests, and to the

manner and degree in which sál reproduction is influenced thereby, it is best to explain all those circumstances and conditions of soil that, viewed through the medium of my personal experience only, would appear to militate for or against the successful and abundant natural regeneration of the species: and since it is now a well-established fact that forests are chiefly affected by the physical properties of the components of the soil, rather than by their chemical composition, I shall, throughout this article, confine my remarks to the former side of the question.

If, selecting a locality noted for the happy results that attend the natural reproduction of sál on its surface, we dig up a seedling of that species—say eight months old—and examine it, the first thing that strikes our attention is the inordinate length of its root, which will be, perhaps, as much as 3 feet long.

We next observe the thread-like tenuity of this root, its delicacy of texture, and general friability. Its whole structure appears to us, in fact, such as must supply an index to its requirements, to its preferences and to its dislikes. We can, indeed, well understand that an organ so soft, so delicate, was not intended by nature for purposes of attack, for any sort of struggle with the matter in which it should find itself imbedded. Its powers of penetration should be extremely limited. And is this not also the case? The soils chiefly affected by sál, what are they? Without exception, porous, loose, unresisting mediums —gravels, sands, boulder-soils—soft yielding substances, or at least soils with alternate openings through which the root of the sál seedling can make its downward progress without more fatigue than is involved in a brief deviation from the direct line of descent.

We have, again, no difficulty in perceiving that the moist and thin epidermal covering of the root before us is but a poor substitute for that tougher coat with which Providence encases the extremities of such plants as are intended by it to fight against drought, and that other extreme of excessive humidity. In its natural habitat of loose, well ventilated soils, the sál seedling has, undoubtedly, to contend, at times, with very considerable difficulties in the way of obtaining a sufficient quantity of moisture. But that it is able to bear a great deal in this way is sufficiently obvious from the often luxuriant crop of sál seedlings observed by us on the crests of exposed mountain ridges—stony grounds drained on either side by precipitous descents, and unsheltered from the heat of the sun, here intensified by the effects of radiation. On the other hand, this difficulty of procuring to itself food, in the absence of the chief vehicle of its supply, is minimised in degree by the natural facilities for descent afforded to the root in this class of soils, and by its predisposition to avail itself to the utmost of these advantages. It must also not be forgotten that there is one circumstance more dreaded by the sál seedling

than comparative want of moisture, and that *is a high temperature.* Moisture and a low temperature are not necessarily interchangeable terms. The loose soils affected by sál have pre-eminently this quality that they are non-conductors of heat, while the dense soils in which the sál is noticed not to reproduce itself freely are, on the contrary, powerful transmitters of the same element. This conductivity of the soils is a matter of extreme importance, in my opinion, to the Indian Forest officer. It explains in part, the less deadly effects of fires on gravelly soils, the greater fatality of the same on stiff loams. Above all, it explains the death of those multitudes of sál seedlings that, in denuded soils of a distinctly clayey nature, take root, year after year, only to wither up on the advent of summer. Is not the vigorous reproduction on exposed rocky, or gravelly, ridges already referred to, greatly assisted by the freshness, as regards temperature, of a soil, the constitution of which is opposed to the transmission of heat into its interior? If any one will go to the trouble, on a hot summer's day, of excavating into the sides of a sandy or gravelly bank—say 3 or 4 feet from the surface—he will be surprised to find how cold to the touch the walls of this cavity will appear to him.

To the Forest officer there could be no greater anomaly, at first sight, than the State forest of Bhinga, in Bahraich. The preponderating species here is sál, but the soil itself is about as stiff a loam as could be found in a day's walk. Over large areas there would appear to be absolutely no vegetable-soil whatever, while, on the average, the latter is only a few inches deep. A tenacious, ochrey, intractable clay of great depth, and unrelieved by more than a few particles of "kankar" gravel, such is the subsoil, and such is only too often the surface-soil itself. The question is how can sál have ever reproduced itself freely under such conditions—conditions reconciling themselves so ill to what we know of the requirements of the species. That sál did propagate itself in this forest, and even flourish splendidly, is obvious from the great number of very fine trees that we meet with. However, to one knowing the circumstances peculiar to a healthy sál forest, and who shall have examined the present locality with care, there will be no great difficulty in solving a problem that is, after all, a sufficiently simple one. To him it will be evident that sál never did reproduce itself freely in this soil, that the soil has undergone a great change. And, in fact, numerous as old trees of the species are, we meet with no fresh evidences of successful sál reproduction; indeed we see hardly a sál tree of recent age. On the other hand, we cannot help perceiving that there is a plentiful young growth of such species as have no objection to, even if they have no decided preference for, soils of a dense constitution. Among these stand foremost in Bhinga the Ebony (*Diospyros Melanoxylon*), the Bael (*Aegle Marmelos*), the Sitána (*Zizyphus xylopyra*), the Haldu (*Adina*

cordifolia), the Kúsum (*Schleichera trijuga*), the Bahera (*Terminalia belerica*), the Asna (*Terminalia tomentosa*). Apparently, the whole forest is in process of rapid transition. Familiar as we are with the classes of soil for which the sál shows a predilection, a predilection so great as to border on vital necessity—as is well instanced in the always sharp outlines of sál forests—we have no difficulty in understanding the great change going on before us, or in realizing how very different all this soil must formerly have been, and that at no very remote period of time.

After spending a few months of the rainy season in this forest, and carefully observing the phenomena attending the germination of the sál seed, and the subsequent development of the plant, we begin to appreciate all those adverse conditions that militate so fatally in the locality against the chances of young sál life. The nature of these conditions has already been dwelt upon in my references to the baneful influences of very clayey soils on the sál seedling—influences which would appear to be exaggerated, in the present case, by every unfavourable circumstance that could well be imagined. Among the latter I shall only mention excessive grazing, and its result of exposing an already too denuded surface to all the fierce heat of an Indian sun. The surface of the ground, in Bhinga, is, in most places, so indurated, and the soil so dense, that very much of the sál seed perishes in the unabsorbed waters that are common to that period of the year. Such seed as take root have the appearance, in the resulting young plants, of being healthy and vigorous so long as the monsoons last. Examination of the root, however, brings to light, in every instance, one fatal shortcoming: it has not gone deep enough. Its extremity will often be found to have rotted. In all cases it will be seen to have swollen and become coarse at the expense of that linear development so characteristic of the healthy subject. Knowing as we do the furnace-like heat to which the upper layers of this soil will be exposed later on, we already foresee that which will surely happen—the universal withering up of all these sál seedlings.

A small extent of the Bhinga forest—some 5 square miles—has been strictly preserved from pasture for many years past, and here alone do we meet with any sál seedlings of more than a year old. In this closed tract the forest has grown more dense, much more dense, and the surface-soil is being gradually loosened and modified by adulteration with vegetable matter. Still, the improvement in the soil, under these more favourable circumstances, is not yet sufficiently advanced for the healthy development of the sál seedling, which survives in the form of a weakly plant, apparently without any certain future before it.

What is the nature of the great change that the soil in Bhinga has undergone since those days when sál prospered there, and allowed of no rivalry?

In many parts of the forest, where the subsoil is exposed, the vegetation scanty, and the ground on an incline, we have little difficulty in perceiving the effects of erosion.

Nobody visiting Kukurdaree, or the southern and western limits of the forest—for say half a mile inwards—can fail to be struck with this circumstance. The few trees here met with, even the thorns themselves, stand on 'cushions', little island knolls of their own, that their spreading tops and encircling roots have preserved from the general wreck around.

But the almost level configuration of the ground that distinguishes the greater portion of the Bhinga forest makes it impossible for us to suppose that the original soil can have been removed by the agency of water. Yet either there has been removal of the soil—complete, or partial only—or there has been a further disintegration or decomposition of its elements. The great depth and uniformity of the clayey subsoil forbids, however, the theory that there can have been any change going on in its surface layers of the nature of disintegration or chemical modification. Look around us as we may, there would appear to be but one solution of the question, namely, that the present vigour of the soil was, in the better days of the forest, neutralized by the excessive quantity of vegetable matter with which it was impregnated, and by the thick coating of mould that covered its surface. And, if we examine the circumstances of the soil in healthy portions of the Motipur and other forests of sál in this district, and study the visible improvements already being effected in such parts of the Bhinga reserve as have been long closed to cattle and fires, we are at once fortified in this belief. Over large extents of Motipur and Chakia, the soil, now supporting vigorous sál growth, would be undoubtedly very stiff in quality, but for the large admixture, in its substance, of vegetable manure. It is my opinion, therefore, that we have in Bhinga nothing more than an instance of soil deterioration on a gigantic scale, a deterioration that has progressed slowly through generations of time, the inevitable consequence of unceasing destruction by man, of pasture, fires, exposure to sun and air, and the resulting exhaustion of *that only element of original fertility in this otherwise purely argillaceous soil.* Restore this vegetable manure, and, in my opinion, you restore the forest at one and the same time. But this restoration signifies no more fires, no more pasture, no more fellings, no more removal of produce—not even grass—for two score of years. Who will say yea to all this? Seeing how rapidly the unclosed tracts of this forest are being denuded by the privileged populations, shall we not soon hear a great cry on their part to be allowed into the protected areas? And will Government resist the appeal of the local authorities, when this *most sure* event shall come to pass? The formation of vegetable mould, that great neutraliser and destroyer of intractable qualities in the

soil, that grand fertilizer of its physical properties, is only rendered possible in humid surroundings, under circumstances where evaporation is a slow process, and the locality sheltered in a high degree from both sun and wind.

But if, in the Bhinga forest, fires have devoured the mould desiccated by exposure, and the free inlet of sun and air has made further accumulations of it impossible, if the hitherto highly impregnated soil has been bereft of all its remaining riches in the ordinary course of vegetable life, a most formidable agency of ruin and destruction remains to be described. I refer to the ever-busy colonies of white-ants, whose numerous hillocks—sometimes as many as fifteen to the acre—constitute one of the most conspicuous features of the Bhinga forest. Neglecting the almost certain fact that the termites consume a considerable quantity of the forming vegetable mould, these only too industrious insects are mischievous in quite another direction, and on a much more serious scale. Each one of these tiny Neuroptea is but a living pump, and by the united force of their myriad numbers, an immense quantity of unkindly subsoil is annually brought to the surface, to be there spread out, wherever the protection of the neighbouring trees is deficient, into even sheets of a plastic and impenetrable cement—a soil so inhospitable that, until much diffused in the progress of years, even the lowliest herbs cannot grow upon it. An observing visitor to the Bhinga forest will not fail to notice the many blanks, from a few hundred square feet to acres in extent, which characterize it. These void spaces bear many points of close resemblance to one another in the generally barren nature of the soil, its white coloration, and the numerous evidences of extinct and living ant-life—evidences that range from the not wholly demolished hillock to the white circular deposit of unusually cement-like earth. Before walking very far inside the Bhinga reserve, the observing stranger will descry this process of soil deterioration going on in all its different stages, from the truncated cone just attacked by the advancing monsoons to the three or four mounds littering with their detritus half an acre of ground. Wherever we proceed, we notice, at short intervals, either towering ant-hills, or the evidences of their past existence, and it is impossible for us to neglect the immense importance of the part played by termites in forest economy.

I have now done with the subject of soils in so far as the Bhinga forest is concerned. It has been treated of at great length, not only because of the great extent of this Government estate—over 160 square miles—but because of the important deductions that follow from a knowledge of its circumstances. Considerable tracts of other Government sál forests in Bahraich are in like case with that of Bhinga: witness those portions of the Sohelwa forest that lie off Bhagoratál, Bilaspur, and Gub-

bapur-Kulán; witness the whole easterly half of the Chakia forest, and some 10 square miles of the Motipur sál forest extending from Dharmapur all the way to Kharia. Much of this deteriorated soil in Chakia, and almost the whole of it in Motipur, is the result of active erosion, whereby the denuded soil is being swept away in annual increments. The fearful effects of this agency of destruction are wonderful and characteristic in the regions of the Motipur forest already referred to. It need hardly be said that all these ruined tracts border on cultivation, and that the hand of man is seen, as the original cause, in each instance of ruin.

Elsewhere in Bahraich, a more sandy constitution of the soil has counteracted many of the evil influences that have been at work. But since even sandy soils are liable, on level surfaces, and under constant pressure, to assume much of the density of purely argillaceous mediums, we are not surprised to find reproduction of sál very backward, very unsatisfactory on the extensive flats that make up so much of the Gubbapur and Murtiha blocks, heavily grazed over as they are. All those fine patches of sál forest which relieve the otherwise very sickly appearance of the stock in Murtiha, arise from the sides of deep basins, or occupy the entire superficies of a few gentle depressions—situations which permit of the excess of clayey particles being washed away, and of accumulations of loose soil being formed from the erosion of neighbouring high grounds. These rich basin forests are also very characteristic of the Nishangara block, although they there cover much larger areas of ground. Peculiar also to both blocks is the barren denuded appearance of the high-lying tracts intervening between these successive hollows, wherever the ground is rapidly undulating. The subsoil of a hard indurated loam is there superficial, and such little soil as results from the process of disintegration, finds its way into the bottoms on either side, as already explained. The tendency of sandy loams to become very dense on their surface, when exposed to the sun, and subject to much pressure, is a very natural circumstance on level grounds. Because the waters of the monsoon bring the clay on to the surface where it is deposited in a very pure state, to be hardened by the sun and by the feet of cattle into the consistence of a brick. On hilly ground, and on all slopes, this clayification of the surface is counteracted by the washing agency of the waters in their course to the lower levels, and by the facilities afforded for such action. For this reason also, grounds that are inclined, unless constituted of pure clay or rock, are very loose, open soils—at least on their surface.

When we ascend from the low grounds of Sohelwa, with their stiff loams of the Bhinga type, we immediately come on to the usual sub-Himalayan formations of gravel, sand, and boulder, all soils most suitable to the natural regeneration of sál.

In certain parts of Nishangara and Murtiha, we come across

deep banks of almost pure sand, in which the particles are principally mica, and which have evidently been deposited in their present position by the action of the Koriala river, when the latter flowed, as it undoubtedly once did, immediately under the present high banks which so strongly define the limits of this great sál forest to the north and west.

There is a characteristic bank of this alluvial deposit within 50 yards of the Nishangara rest-house. Perfectly loose, and without any cohesion, but strongly impregnated with vegetable matter, the very finest natural reproduction of sál is met with on this class of soil.

Off Bachkhall, and in many other parts of the Gubbapur block, in Sohelwa, we note rather low-lying bottoms that are subject to the periodical washings of neighbouring very ill-defined water-courses. As a consequence, the clayey particles of the soil have been here all carried away, leaving a very pure sand behind. These localities are always densely covered with young forest of pure sál. We observe again how, in Gubbapur, where ravines interrupt the level surface of extensive plateaus, the banks and broken ground subtending these ravines are similarly well covered with young sál trees. The cause is always the same—the washing, *in moderation*, of a stiff, dense soil, and the removal of that excess of clay which imparts those unsuitable qualities to the soil—unsuitable in so far as sál is the species concerned, sál which must have an open soil, and prefers it to be loose to the verge of non-cohesion.

E. P. D.

A VISIT TO THE CITY OF CANTON.

WHILST passing Hongkong last April *en route* for Japan and America, I had an opportunity, whilst waiting for the sailing of the P. and O. steamer, to pay a flying visit to Canton, and some account of that curious city may be interesting.

The voyage to and from Canton from Hongkong is easily performed in about seven hours each way, by means of a fine line of river steamers, built on the model of the American river boats, one of which leaves Hongkong and Canton at 5 p.m. each evening, so that in going up the traveller sees the lower portion of the river, and in returning the upper part can be examined by day light. The lower half of the Canton river is not very picturesque, and the low hills and fields were green and pleasant looking at the time of my visit, but generally denuded of tree vegetation. After passing the remains of the famous Boyne forts, near which others of a still more formidable nature are now being constructed, the scenery becomes much more interesting, and continues so till Canton is reached, the whole distance from Hongkong being 75 miles.

At a place situated about 10 miles below the city we found the river blockaded by means of a line of piles and boulders, this precaution having been taken in connection with the late French difficulties, a small opening for traffic only being left, through which the steamer passed.

The banks of the Canton river are, as a rule, low, and wherever the soil is suitable numerous paddy fields are seen, which were being carefully manured by means of liquid manure brought down in boats from Canton. I observed that efforts were being made to increase the area of these fields by reclaiming waste land from the river, by means of extensive dykes and embankments.

At various places along the banks there are numerous low hills, which are generally surmounted by Chinese temples or "Joss" houses, surrounded by fine groves of pines, bamboos, and cotton-wood trees. There are also several stately pagodas scattered over the country near the river, which, however, do not seem to be much cared for, as numerous shrubs and trees are growing out of the masonry. From 10 to 15 miles distant from the river on each bank, ranges of mountains of considerable elevation are observable, which are generally bare of forest vegetation, but a few patches of what appeared to be pine forest were visible here and there. There seemed to be a considerable traffic on the Canton river, and many steamers and junks of all sizes and descriptions, both for war and peaceful purposes, were passed.

The neighbourhood of the city which occupies both sides of the river, simply swarms with small boats of all kinds; there being in all a "floating population" of about 65,000, the term being used in its literal sense. Many of these boats are merely used as habitations, the occupation of the owners being that of tending ducks and geese, or carrying on various kinds of small trades. These are generally called "flower boats," but I was told that the term ought more strictly to be applied to those boats devoted to pleasure trips.

Early next morning I started, accompanied by a trustworthy guide, to see the sights of this famous city, a brief account of which I shall now attempt to give.

The streets of Canton present a most unique and remarkable appearance, being only about 8 feet wide, and the whole space between the houses and 8 feet above the roadway is literally crowded with sign-boards of all colours, either suspended or projecting from the walls at right angles to the streets, the whole being mixed up with variously coloured lanterns of all shapes and sizes.

The population of Canton being about one-and-a-half millions, the streets of course teem with Celestials, which circumstance, however, did not prevent the chair coolies from shuffling along at a fair pace, shouting "Ah ho," and the manner in which they

managed to cut the sharp corners without coming into collision, was most creditable from a piloting point of view. All Chinamen seem to stick rigidly to their national costume, and considering that no police were visible, perfect order seemed to prevail.

A considerable number of Chinese ladies were met with in the streets, and I observed several with feet not exceeding 4 or 5 inches in length and about 1½ inches in breadth, which circumstance, however, did not prevent them from hobbling along in a fairly active manner. In some parts of the city of Canton the shops are of a superior and pretentious description, and consist of those of lace, silk, fan painters, carvers in ivory, wood, and tortoiseshell, also jade stone and lacquer-ware establishments, besides which there are of course endless others of a more practical description, such as lantern makers, butchers, fish shops, blacksmiths, carpenters, &c., all of which seemed to be driving a roaring trade. One peculiar feature of these shops is that every tradesman makes his calculations on a kind of square plate shaped something like a gridiron, with a number of small balls running up and down the ribs, by the aid of which contrivance the most abstruse calculations can apparently be worked out.

In traversing the city I observed numerous wood and fuel depôts, a kind of pine, probably (*Pinus Thunbergii*), being most in use, which together with bamboos enters largely into the construction of Chinese houses.

The fuel most used consists of hard woods, and is offered for sale in neat bundles of about 10 seers weight, the billets being split and sawn into 18-inch lengths. All charcoal, principally in large pieces of not less than 4 inches in diameter, was made up in neat bamboo or grass baskets of various dimensions.

The principal temple or "Joss" house visited was that called Honan, which is constructed of wood, but the general appearance is not very imposing. This temple contains various gigantic statues of Buddha, made of wood elaborately gilt, besides which there were various satellites in the form of demons of all colours.

This temple is surrounded by a fine grove of *Ficus* trees, and in a neighbouring building 12 sacred pigs were shown, all of enormous dimensions and much too fat to move.

We next visited the residence of a private Chinese gentleman, with whom the guide seemed to be acquainted, and I was much struck with the neat internal arrangements and decorations of the mansion.

Amongst various chambers shown, I noticed one devoted to the smoking of opium, and specially fitted up for that purpose. One side of this house was occupied by a lake and garden decorated with flowers, shrubs, rustic bridges, and trees cut into various fantastic shapes.

We next inspected what is called the temple of 500 Genii, where there are four immense statues of Buddha supported by 500 saints, mostly of ferocious aspect, amongst whom there is one representing the famous Venetian traveller Marco Polo.

From thence we proceeded to the examination hall, where the examination of candidates for Government appointments, degrees, &c., takes place once every three years.

The importance of this contest may be judged of from the fact that the compound of the hall is divided into 10,000 separate cells, to which the candidates are condemned to solitary confinement for two days and nights, till they complete their papers, which consist principally in writing elaborate quotations from ancient Chinese authors. Notwithstanding the careful precautions taken, all kinds of abuses and frauds are said to take place, and sometimes a wealthy candidate, by means of judicious palm-greasing or otherwise, can manage to send a substitute, who of course passes with *éclat*.

From the examination hall we proceeded to the city wall, along which are planted a most antique collection of rusty cannons, which if fired would doubtless prove more dangerous to the defenders than to their enemies.

From a five-storied pagoda situated on the highest point of the walls a fine view of the city and surrounding country is obtained.

The vicinity of Canton consists of an undulating country, the valleys and low lands being utilized for rice cultivation and vegetable crops, a most elaborate system of irrigation and manuring being of course practised.

The low hills in the immediate neighbourhood of the city are employed as cemeteries, and immense areas are covered with graves, which the Chinese appear to construct in a circular form, something in the shape of a horse-shoe.

All the other hills are bare of forest vegetation, and few trees of any kind were noticed in Canton or its neighbourhood, with the exception of cotton trees (*Bombax?*), pines, Persian lilac, *Ficus* of sorts and bamboos.

We next visited what is called the "temple of horrors" situated in the most populous part of the city, which consists of three or four large vaults or cells filled with plaster figures representing the trial, torturing and execution of criminals, after various barbarous methods.

This temple I was told is considered specially sacred, and numerous devotees were engaged in their devotions, one of the most important rites of which apparently consisted in lighting a "Joss" stick, which may be described as a kind of taper. I noticed that the immediate vicinity of this temple swarmed with fortune tellers, card sharpers, quack doctors and miscellaneous vendors of every description, all of whom seemed to be actively engaged in swindling the unwary. A Mandarin's court

was next visited, when various prisoners accused of thefts, &c., were being tried.

These men were brought in with chains round their necks, and placed on their knees before the august Magistrate, who soon disposed of them in a summary manner. One man who either refused or failed to make an expected confession, was suspended by the thumbs and big toes, which torture he endured for about twenty minutes, when he fainted, upon which the Magistrate ordered him to be let down, which the jailors did in no very gentle manner, and when we left the court the unfortunate wretch was still lying insensible on the floor.

We next visited the neighbouring jail, which was crowded with prisoners of forbidding aspect, and the general conservancy and lax discipline of the establishment would rather astonish the most benign Superintendent of an Indian jail.

From the jail we proceeded to the execution ground, the space devoted to this important purpose being of the most limited extant, probably not exceeding 300 × 100 feet, and at the time of my visit the space was occupied by potters busily engaged in making earthen stoves, basins, &c. The executioner, who seemed to be on the look out for travellers and "bakshish" soon appeared on the scene, and with many "salaams" and smiles exhibited his sword, which I found to be a heavy murderous looking weapon. I was informed that about a month before my visit this man decapitated as many as 23 prisoners one morning in succession, the whole tragedy having been completed in about half an hour.

It may be observed that in China there is said to be a class of beggars who volunteer to have their heads cut off as substitutes for others, on the payment of a moderate sum, which goes to his relatives and friends, so that if a criminal can raise the necessary funds he can generally escape the final penalty of the law.

Having "done" all the principal sights of Canton, we next proceeded to the foreign settlement, called Shamen, situated on a small island on the right bank of the river, where all the Consuls and principal merchants reside, glad to escape from the odoriferous city, the smells encountered during the day having been somewhat overpowering.

My stay at Hongkong having been extremely limited, I found that I had no time to visit the planting and other interesting forest operations described from time to time in the "Indian Forester." From a distance however, I observed on the hills surrounding the harbour, several extensive areas apparently planted up with pines and other trees in lines running perpendicular to the slopes, some of which appeared to be about 12 feet high, and seemed to be flourishing. Judging from the nature of the climate and appearance of the soil, the success of planting operations at Hongkong is probably not

nearly so uncertain as in most parts of India, and owing to the frequency of showers the dangers from fire must be much less.

There is apparently very little natural forest growth on the Hongkong hills, but a few patches of pines, probably *Pinus Thungbergii*, are seen scattered here and there.

From the casual look I had of the town of Hongkong, it seems to be a thriving place, with a magnificent harbour crowded with the shipping of all nations, and it was most satisfactory to notice that steps are now being taken to erect formidable fortifications. The town is well built, and even the Chinese quarter is clean and prosperous looking.

The Police force is mainly composed of a fine body of Sikhs, in addition to which there are a limited number of European and Chinese constables.

I must not forget to mention that I made a point of visiting the famous "happy valley," which is easily reached by Jinrickshaw in about half an hour, this conveyance being now the common mode of locomotion in China and the East.

This beautiful spot consists of a valley surrounded by spirally wooded hills, the level ground constituting a race course, whereas the lower slopes of the hills have been used for the purpose of a cemetery since Hongkong was occupied in 1841, and thousands of the former inhabitants now lie at peace there, surrounded by a most picturesque combination of pines, bamboos, cotton-wood trees, mangoe, *Ficus auracaria*, and other forest trees, as well as flowering shrubs of great variety.

E. McA. M.

TIMBER MEASUREMENT IN UPPER BURMA.

THE system of timber measurement and calculation of Burmese tons (*athas*) in Upper Burma is very curious, and will, I think, be of interest to Forest officers in British Burma. It is in general use here, and, to one new to the province, is very puzzling, and no reason can be given by the Burmese for the inproportionate relations between logs of different sizes to the standard of cubic measurement, except that of long established usage.

Linear measurement.—The table of linear measurement is very simple. The *taung* (cubit) is the standard. It is divided into four quarters, each called a *sŏk*. Every Burman when about to measure round timber, manufactures his own *taung*. A bamboo stick is smoothened with a *dah*, and sixteen rupees are laid side by side on it. The portions remaining on both sides of the rupees are carefully cut off, and the *taung* is ready. A straight mark is made at every four rupees for the *sŏks*, and a cross mark at every other two rupees for the half *sŏks*. The *taung*

measures a little more than 19 inches. In very rough measurement, the length from the elbow joint to the tip of the middle finger is supposed to equal a *taung*. In that case *sôks* are not quoted, but instead there are *twa-s*, *meik-s* and *let-thit-s*. A *twa* is a span; a *meik* (about 6 inches) is the length from the last joint of the little finger to tip of the thumb, the fist being closed tightly, and the thumb stretched out as much as possible; a *let-thit* is a finger breadth.

Cubic measurement.—The *atha* or Burmese ton is the standard of cubic measurement. The following is the table :—

2 annas (pè)	=	1 *mú*.
10 *mús*	=	1 rupee (*kyat*).
3 rupees	=	1 *atha*.

The rupees and annas of the above table must not be confounded with the coins of the same name. In most Burmese industries, the particular standard is divided into rupees, *mús*, and annas, and it bothers one not a little when the value of an article is required, to calculate from rupees (of measurement, weight, &c.) to rupees (of money).

Manner of measuring logs.—All actual measurements of girth are carried on by means of split canes. Elsewhere logs are generally measured at the middle, but in Upper Burma the exact place of measurement is decided as follows :—

Length of log.		Place for measurement of girth.
12 *taungs* (18 feet),	... 3 *taungs* (4½ feet)	from base of log.
15 „ (23 „),	... 4 „ (6 „)	„ „
20 „ (30 „),	... 5 „ (7½ „)	„ „

and so on, for every addition of 5 *taungs* in length, the girth is measured one *taung* further from the base.

The length is measured in the ordinary style, all logs from 12 to 14 *taungs* in length are classed as 12 *taungs*; from 14 to 19 *taungs* in length as 15 *taungs*; from 19 to 24 *taungs* as 20 *taungs*; and so on.

I may here add that it is not usual to cut timber of any size under 12 *taungs*.

The following is the procedure usually followed in measuring timber :—

The price of the timber having been settled on, as also as to who shall pay for the split canes, the buyer and seller arrive at the spot where the timber is lying, at the appointed hour. Each brings a man with him to assist in the measuring. The buyer's assistant marks out the exact place of measurement in accordance with the rule given above, and girdles the log with a split cane, pulling tightly at both ends. The seller's man then with a *dah* cuts the cane where the ends cross one another. The cut cane (now the exact girth of the log) is made over to

the seller. In this way all the logs are girdled.* Each cane is now taken and bent into two equal lengths. The bent cane (half the girth) is then measured with the *taung* measurement stick, and the result noted in *sóks*.

Method of calculating "athas" or Burmese tons.—There is no fixed relation between linear and cubic quantities; a *taung* is the standard of linear measurement, and an *atha* the standard of cubic measurement. A log of 12 *taungs* in length and 8 *sóks* in half-girth is considered to contain an *atha*, while another log 20 *taungs* in length, and of the same girth, though not twice the volume of the first log, is considered to contain two *athas*. If a Burman is asked why this should be, he says he cannot tell, except that it is a long established custom.

The following is the table for calculating Burmese tonnage:—

Measurement of half-girth.	Length of log.	Cubical Contents.			
		Athas.	Rupees.	*Mus.*	*Pès.*
3 *sóks.*	12 *taungs*	..	..	2	..
3½ „	„	..	..	3	..
4 „	„	..	..	4	..
4½ „	„	..	..	5	..
5 „	„	..	..	6	..
5½ „	„	..	..	7	1
6 „	„	..	1	..	..
6½ „	„	..	1	5	..
7 „	„	..	2	..	..
7½ „	„	..	2	5	..
8 „	„	1	..	..	..
8½ „	„	1	..	5	..
9 „	„	1	1	..	..
9½ „	„	1	1	5	..
10 „	„	1	2	..	..
10½ „	„	1	2	5	..
11 „	„	2	..	..	..

It will be noticed that for every increase of half a *sók* in half girth above 6 *sóks*, 5 *mús* (half a rupee) is added to the cubic contents.

The above table is only for logs 12 *taungs* in length. All logs of longer length are *reduced* to logs of 12 *taungs* by adding to the half-girth or multiplying the number of logs according to the following rule:—

1 log of 15 *taungs* in length = 1 log of 12 *taungs* in length

* This word is used in its ordinary sense, and not to mean the well-known operation on trees in Burma preparatory to felling.

increased in half-girth by one *sôk*; thus, a log of 15 *taungs* in length and 8 *sôks* in half-girth is equal to a log of 12 *taungs* in length and 9 *sôks* in half-girth.

1 log of 20 *taungs* in length = 2 logs of 12 *taungs* in length and of the same half-girth.

1 log of 25 *taungs* = 3 logs of 12 *taungs*.

1 log of 30 *taungs* = 4 logs of 12 *taungs*, and so on.

It will be seen from the above table how utterly out of proportion the calculations are.

The following is an example of how tonnage (Burmese) is calculated :—

In the Note-book it is noted—

No.	Half-girth.	Length.	Number of logs.
1	8 *sôks.*	12 *taungs.*	25
2	5½ „	15 „	20
3	6 „	15 „	18
4	6½ „	20 „	16
5	7 „	15 „	8
6	7½ „	12 „	9

These are *reduced* to 12 *taung* logs, and the *athas* calculated as follows :—

No.	Half-girth.	Length.	Number of logs.	Tonnage on one log.			Total Tonnage.		
				Athas	*Rs.*	*Mús.*	*Athas*	*Rs.*	*Mús.*
1	8 *sôks.*	12 *taungs.*	25	0	0	2	1	2	0
2	6½ „	12 „	20 } 52	0	1	5	26	0	0
4	6½ „	12 „	32 }						
3	7 „	12 „	18	0	2	0	12	0	0
6	7½ „	12 „	9	0	2	5	7	2	5
5	8 „	12 „	8	1	0	0	8	0	0
			Grand Total Tonnage, ...				55	1	5

No alterations are made to Nos. 1 and 6, and the tonnage is calculated direct from the table. Nos. 2, 3, and 5 being 15 *taungs* in length, one *sôk* is added to the half-girth; they, therefore, become 6½, 7, and 8 *sôks* respectively. No. 4 being 20 *taungs* in length, is considered equal to twice the number of logs of 12 *taungs*, and is added to No. 2, being of the same half-girth.

The above system of timber measurement will, for some time yet, be the system in general use in Upper Burma, and I write

this in the hope that when a Forest Department is properly established in Upper Burma, it will prove of use to the Forest officers.

MANDALAY, 8*th July*, 1886. } C. INGRAM.

SEEDING OF BAMBOOS.

I HAVE read with great interest Dr. Brandis's notes on the two Himalayan hill bamboos. As no body has come forward to supply information on that subject, I shall try and give a few facts with respect to the different bamboos which have come under my own observation.

In 1881 all the graceful *Bambusa arundinacea*, which adorned the old parade ground and other parts of Dehra, flowered. This was noticed at the time in this Journal by Mr. Smythies and others. In 1883 I was working in the forests in the neighbourhood of Barmdeo-Mandi in Kali Kumaon, and noticed a number of dead clumps of *Bambusa arundinacea*, which had evidently flowered at about the same time as the Dehra ones. The ground near the old clumps was simply covered with seedlings about 4 or 6 inches high. This would seem to point to the Dehra bamboo belonging to the same stock as the Kumaon bamboo.

The young seedlings are making themselves conspicuous in most hedges in Dehra, and are now 6 to 10 feet high.

In Dehra most of the clumps died down immediately after flowering, but I know one case which proved an exception. In 1882 one clump sent up a number of new culms. These, however, flowered again during the present year, and there is as yet no sign of new leaf-bearing culms coming up. As another example of great vitality in certain bamboos, I may mention here that on the same road, along which the above mentioned clump was growing, a clump of *Dendrocalamus strictus* flowered in 1881, sent forth new but thin shoots in 1882. These flowered again in 1885, and now new scraggy and thin shoots are pushing up in the midst of the old clump.

With respect to *Dendrocalamus strictus*, although the flowering is not so general as with other species, yet large areas become fertile at one time. The curious point about the flowering of this bamboo in the Siwalik forests of the Dún and Saharanpur is that the fertility seems to spread onwards gradually and year by year.

For instance in 1883 most of the clumps in the Kharkhari block flowered. In 1884 the Maiapur block, Saharanpur division, became fertile. Then the Ranipur block was attacked in 1885, and this year 1886 the bamboo in Rauli block seeded.

Thus the seeding began in the south-east corner of the Dún, turned the corner of the Siwaliks at Hardwar, and fertility is now apparently gradually spreading westward along the southern face of the Siwaliks. It remains to be seen whether this gradual march will continue along the rich bamboo forests of the eastern and central ranges of the Saharanpur division. Elsewhere I have seen this species flowering only sporadically.

The *Arundinaria spathiflora* flowered in 1882 all over Jaunsar and Tihri Garhwal. This year I saw only very few live full grown clumps of this species, but nearly all the hill sides are covered with little 4 year old seedlings. I send a rough drawing of a seedling showing the small culms given out in three different growing seasons, and a fourth budding one (*see a, b, c, d*), *Fig.* 1.

The *Arundinaria falcata* flowered this year all over the hills of Jaunsar and Tihri Garhwal. Wherever I saw this ringal near Chakrata, Deota and beyond in the Sahlra forest, almost every culm was loaded with flowers. I give a small drawing (much reduced) of part of one of these culms, *Fig.* 2.

The *Dendrocalamus strictus* and *Arundinaria falcata* can, therefore, be considered to flower gregariously as well as sporadically, and there does not seem to be any reason to consider them separate from the other species on account of their mode of flowering.

In 1883 I was working in the hills of Jaunsar, and remember seeing a number of *Arundinaria falcata*, but none of them were flowering.

A. F. Broun.

FORCE OF GERMINATING SEEDLINGS.

As an instance of the force of germination in seeds I may quote the following instance. I lately had occasion to construct some masonry boundary pillars in a khair forest, and I found that in a number of cases khair seeds had got mixed into the mortar which was spread over the surface of the pillars. The seeds in germinating had lifted up pieces of the hardened mortar from depths of often nearly an inch below the surface.

JJ. Reviews.

FORESTRY IN HONGKONG.

We have received Mr. Westland's report on the Botanic Gardens and Forest Department of Hongkong for the past year. He remarks as follows on the cultivation of Rhea :—

"The 'Rhea' or 'China Grass,' *Boehmeria nivia*, seems to be exciting considerable interest amongst planters as a textile, and enquiries as to its cultivation and the means of procuring it have recently been made by local agents and by correspondents at a distance.

"Living plants can be procured in quantity from squatters on the island and from adjacent villages on the mainland. The Chinese cultivate it on patches of the richest soil they can find, and supply it with strong manure water from their cesspools, from the time the shoots appear till they are nearly ripe.

"Several correspondents have asked for seeds of the plant, but I may here mention that none of the squatters whom I have consulted on the subject have ever raised it, or seen it raised from seed, though it is possible to raise it in this way. The favourite Chinese method is to divide the roots into small clumps about 4 or 5 inches square, and plant them out in prepared ground at a foot apart. In this way a crop can be got off the plants the first year. Seedlings would probably take several years before they reached a yielding condition. The plants are usually divided and planted out in February, but this can be done in a climate like that of Hongkong, at any season, if the plants are duly watered."

The planting out of *Pinus sinensis* on the hills above Hongkong proceeds vigorously, 342,000 plants having been planted out since December 1884, and 204,837 successfully sown in pits, besides large broadcast sowing which has produced irregular patches of seedlings. 16,398 *Eucalyptus* of different species have also been planted out, and *robusta*, *citriodora* and *tereticornis* have proved most successful.

The *Cassia lignea* plants have been much injured by the Chinese, who pull off the leaves and branches for medicine. In the following remarks of Mr. Westland we note the superiority of the Sikh Forest Guards of Hongkong to the Chinese :—

"The area of planted land is yearly becoming more extensive, and the trees, as they increase in size, are becoming more valuable, and consequently more liable to be stolen. If wood stealing is not already a profession in the Colony it is likely to become one. This

consideration points to the advisableness of repressing the destroyers of our incipient forests with a strong hand. A coolie who is fined a small sum for having cut down a bundle of small trees has no reason to consider himself harshly dealt with. He may have been cutting trees with impunity for six months, and in this case he will probably have philosophy enough to look upon the fine as a kind of tax, and simply return to his wood-cutting vocation with a resolution to be more careful in avoiding the Forest Guards in future.

"But the loss to the Government will not be compensated by a trifling fine, if the Colony has been ruthlessly deprived of what might have become valuable forest trees at some future date.

"Considering the extent of the ground now planted, and the difficulty of walking over it, it is not surprising that two Forest Guards find it difficult to repress tree cutting. Both the men are Chinese, and are consequently more likely to be intimidated, or induced to connive at an offence which it is their duty to repress than,—for instance, Indian watchmen.

"If it is agreed that the plantations should be more effectively protected, I think it would be well to increase the number of Forest Guards, and endeavour, as far as possible, to modify the danger of the men being improperly influenced in the discharge of their duty by employing Indians instead of Chinese as Forest Guards."

ANNUAL REPORT ON THE FOREST DEPARTMENT STRAITS SETTLEMENTS, FOR THE YEAR 1885.

FOREST conservancy is making progress under Mr. Cantley in Singapore, Malacca and Penang, which constitute the Straits Settlements, and the following summary of the results acchieved is given in his last annual report :—

"In conclusion, I would briefly summarize the more important works of the year in the three Settlements, *viz.* :—Area demarcated, 17,455 acres. Surveyed, 8,865 acres. Length of boundary opened, 61 miles, at a cost of about $62 per mile, and 5 miles planted with fast-growing trees. Length of boundary kept up of previous year's demarcation, 46 miles Area protected, 22,753 acres, being about an average of 1,202 per watchman employed. Buildings erected, seven, being four permanent and three temporary. Area planted, 59 acres; weeded, 64 acres. Weeding and planting taken together cost about $13 per acre. Number of plants propagated, 180,000, at an average cost of $9 per 1,000. Number of specimens for Colonial and Indian Exhibition, 271. Number of Herbarium specimens collected, 4,389. Seeds collected, 300 lbs. Received from India, 86 lbs. Number of prosecutions for illicit tree-cutting, 23. Number of convictions obtained, 15. Area added to nurseries, 9 acres."

Mr. Cantley is beginning to realize that he has valuable indigenous timber in the Settlements, and that they are better adapted than foreign species for re-wooding his waste lands.

He gives the native names for several of these species, but

we can only infer incidentally that *Dipterocarpaceæ* is the prevailing order of valuable timber trees.

He has had a difficulty with his Overseers, two of whom resigned, as the duties of the posts are arduous and trying to European constitutions, and he has applied to the Home Government for an officer to fill one of the posts.

Perhaps he might utilize the Dehra Dun Forest School for the training of Rangers, as was at one time proposed for the Ceylon Forest Department.

The salary of Overseer rises from $600 to $800 per annum, being about the same as that of our 2nd and 1st grade Rangers.

The forests in the Straits do not appear to yield any revenue at present, but an allotment of $20,000 per annum for their maintenance is assigned by the Government.

CALCUTTA ROYAL BOTANIC GARDEN.

Dr. King's report for the past year 1885-86 on the Calcutta Botanic Garden, now in its 99th year, is short, but contains some points of general interest.

Such a large quantity of mahogany seed was received during the year from Jamaica, that though much of it was distributed, there are now 20,000 healthy young seedlings for distribution in the gardens. Mahogany is a very hardy tree, and grows luxuriantly in Bengal, where there appears to be no reason why large plantations should not be started in favourable sites.

The *Broussonetia papyrifera* is also thoroughly at home in Calcutta, as in Dehra Dun, in either place attaining a height of 30 feet in 4 years, when as Dr. King says "it seeds freely, and when felled throws up vigorous coppice shoots and root-suckers, if the roots are cut underground by the free use of the hoe. The Japanese cultivate the tree as osiers are grown in England, and only the young shoots are used for paper manufacture. Home manufacturers pronounce it to be nearly, if not quite, the best of paper fibres, its bark yielding 58 per cent. of bleached fibre and requiring little bleaching."

Regarding the Darjeeling Botanic Garden we read—

"It is slowly recovering from the ravages of the cockchafer grubs which killed everything in it except the larger trees. Some bunches of grapes were produced by the vines, but owing to the absence of sufficiently bright sunshine during the rainy season, the fruit was rather small and sour. Dr. King fears that the Eastern Himalaya is pretty nearly hopeless as a home for any European fruit but the strawberry, the success even of which is not much to boast of."

REPORTS ON THE EFFECTS OF FIRE-CONSERVANCY ON THE RAUS OF THE SAHARANPUR DIVISION.

DURING 1885, I explored several of the raus of the Southern slopes of the Saháranpur Siwaliks, and examined in detail those forming the catchment basins of the Dholkhand and Sampwala raus, and portions of the forest near the Mohand, Súkh, Chikna, Chillawala, Binj, Bám and Bethan raus.

I have thus been able to gather a fair amount of information respecting the influence of fire protection on hill slopes.

About thirty years ago the Siwalik forests were leased, the lessees obtaining the right of cutting whatever they chose between the Ganges and the Jumna. Thus the hill sides were gradually denuded, and had the forests not come under the more careful management of the Forest Department, fellings, fires and heavy grazing would in a few years more have brought the southern slopes of the Siwaliks here to the same state as those of Hushiarpur.

Although the fellings were then reduced, fires and grazing went on for many years.

Dr. Warth, when in charge of the Division, foresaw the advantage which would accrue from protecting the upper slopes of the Siwaliks, and in 1880 recommended the closing of the forests of the Ratmau basin in order to protect the Ganges Canal from the effects of its floods. The Dholkhand block was closed in consequence before the end of that year.

The closing of a forest is always followed by the springing up of a heavy and dense crop of grass wherever the cover is not dense enough to prevent its growth.

As explained above, the trees are dotted here and there on the slopes, being somewhat more numerous in depressions and near sóts and raus.*

The species most abundantly represented are chir (*Pinus longifolia*) on crests and near the main watershed; sál (*Shorea robusta*) dotted here and there all over the slopes; bamboo (*Dendrocalamus strictus*) in cool ravines; sain (*Terminalia to-*

* Sót = Narrow water channel, with steep sides. Rau = broad water channel with boulders.

mentosa) in cool moist places; bákli (*Anogeissus latifolia*), thanela (*Gardenia turgida*), harsingar (*Nyctanthes Arbor-tristis*), occasional khair (*Acacia Catechu*), *Cochlospermum Gossypium* and other trees scattered all over the face of the hills.

Now among the trees most abundant, chir is chiefly young and only just beginning to seed, and the trees are so far apart that perhaps fecundation is impeded. Bamboo has not flowered since the closing of the forest, and by its seeding little would have been gained, since all the parent clumps would have died. As for sál, bákli and harsingar their seeds are such that they cannot easily reach the ground in a healthy state where there is dense crop of grass, sál on account of the wing-like appendages of its seeds, bákli on account of their lightness and smallness, and the quickness with which they rot, and harsingar on account of the flat shape of its seeds; khair, thanela and cochlospermum being rare, need hardly be taken into consideration; and on exposed slopes the few seedlings I saw were nearly all of thanela.

On the hill sides in the open forests, although grass is burnt down every year, seedlings of sál and saplings of bákli are far more abundant. Still they are not in such abundance as to counterbalance the beneficial influence of grass with respect to protection of the hill sides.

It is stated on good authority that, in the Central Provinces, under the influence of fire protection and irrespective of cover, the grass becomes thinner and shorter every year until it is only about half a foot high. The reason for this is ascribed by Mr. Fernandez to the trees developing roots near the surface of the ground, which not being killed down by fire gradually drive out the grass. Besides, old grass forms a bad humus for new grass to spring up in, and grass thrives chiefly when frequently coppiced (as by fires); if, therefore, the grass be not burnt, the new shoots come from an uncoppiced rhizome, and therefore get continually weaker.

As far as my own experience goes, the grass in some of the fire protected forests in Dehra Dún, where there is a fair amount of cover, certainly appears to me to be less high and dense now than a few years ago, but in Saháranpur this result has not yet made itself apparent. The grass on the contrary is much coarser in fire protected than in open blocks. The men who cut bhábar grass, of which there is a large export for ropes and for the Lucknow Paper Mills, neglect that which comes from closed blocks, as they consider it far too coarse for use. However, the forests have only been closed as yet for 6 years, and we may still hope to see the grass thinning itself sufficiently to allow sál and bákli seed to reach the ground easily.

As long as we do not get a good crop of seedlings, this heavy growth of grass is the next best thing, for it acts as a sponge and delays the rapidity of the surface drainage.

As a proof of this, one has only to compare a protected and a non-protected rau where they come out of the hills and the cone of dejection begins to form.

At this point a non-protected rau consists of a chaotic mass of boulders and pebbles without any defined channel, the water making a new channel for itself during each flood amidst this mass. Islands with vegetation are rare, and where such exist they are only partially stocked with old trees, showing that at these places some flood severed them from the main land (if it may so be called).

In protected raus, on the contrary, the channel divides itself into a number of well defined channels enclosing islands on which the fine silt, which used before to be carried far down, is deposited, and in such places a dense crop of sissu seedlings is soon sure to follow; these seedlings with their roots consolidate the soil and arrest the silt which comes in the following floods; soon after the sissu, khair also usually springs up, and gradually, in the midst of what a few years ago was only one mass of shingle, a young forest of sissu and khair appears. The best examples of this are the Dholkhand and Binj raus. In some places, as in the Binj rau, *Acacia eburnea* replaces the khair; and in others, as in the Chikna, Gaj and Maluwala raus, káns grass precedes the sissu.

Some old subordinates have often remarked before me on the spread of khair and sissu in the midst of raus since the forests were closed.

The second effect of the growth of grass is that, besides checking the rapidity of the surface drainage, it also diminishes it, by allowing the water to filtrate into the soil.

Forest guards have several times complained that, whereas formerly the water in the raus used to come down close to the Hardwar-Khara road before it disappeared, they have now every year to go higher and higher up the raus to get drinking water.

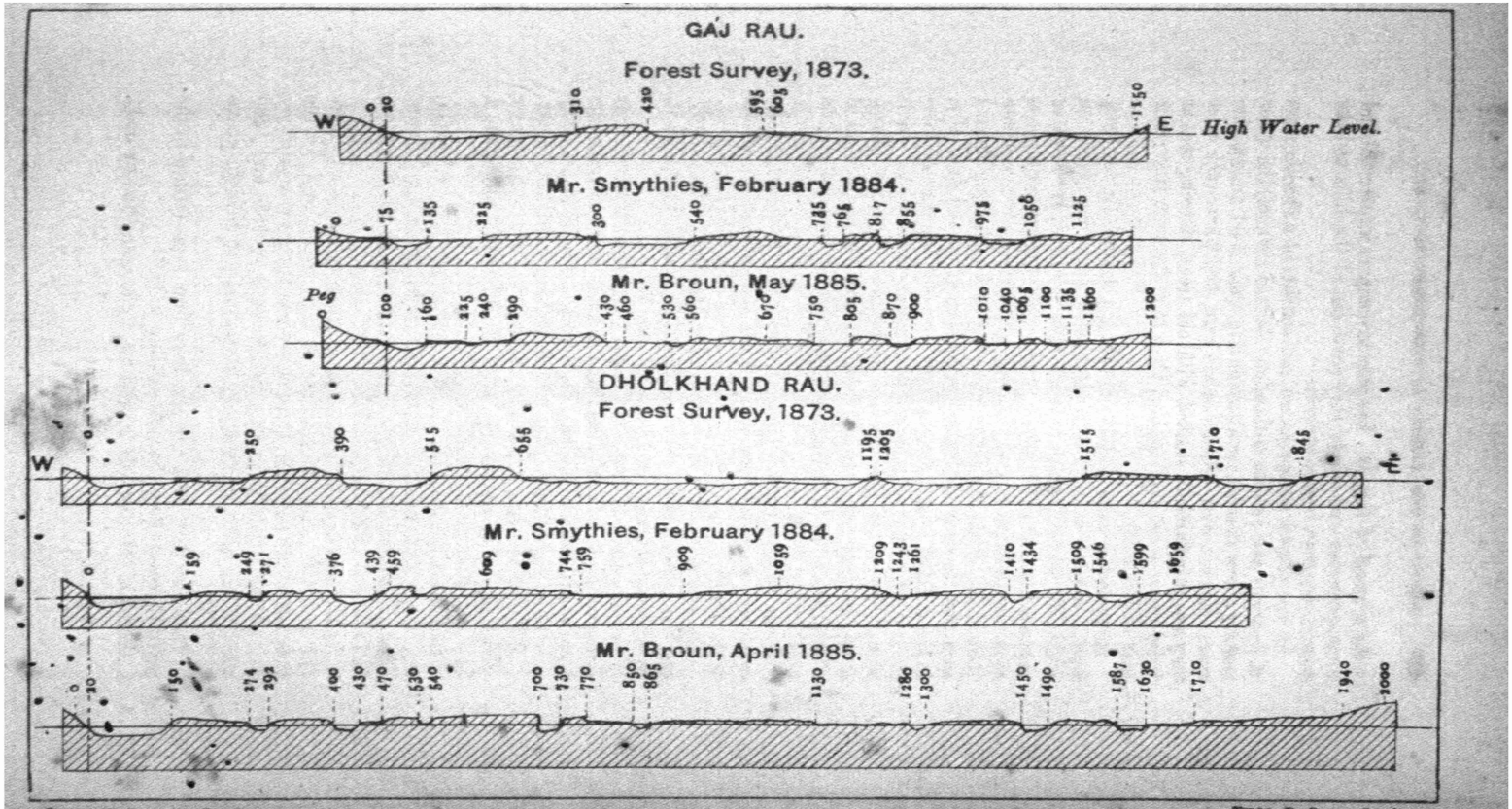
Whether the supply of water is more steady and regular where the water re-appears, below the "Bhábar" formation, I have not had time to ascertain.

Sections are given on the accompanying Plate of the Gáj and Dholkhand raus, showing their width according to forest survey measurements in 1873—measurements by Mr. Smythies, in 1884, and by myself in 1885.

As the lines of measurements were probably somewhat different each time, and the estimate of high water level not the same with each surveyor, these measurements are valuable only in so far that they show that the channels in 1884 and 1885 more or less agree, whereas they were usually at different places in 1873.

They also show that deposits have now been formed in the midst of broad stony channels existing in 1873.

Accurate data can only be obtained by levelling and by mak-



Litho. T. C. Press, Roorkee.

THOS. D. BONA, *Supdt.*

ing the measurements exactly over the same line year after year, which method has, I hear, been followed this year.

DEHRA DUN; *The 5th May, 1886.*

A. F. BROUN,
Offg. Deputy Conservator, late in charge, Saháranpur Division.

The general results of fire-conservancy may be stated to be—

(*a*), the raus have decreased decidedly in breadth;

(*b*), the courses of the raus tend to become permanent;

(*c*), floods are spread over a longer time than used formerly to be the case.

The decreased breadth of the raus is noticeable to the most careless observer. The old limits still exist and within them young growth of grass jungle (kán, sarkara, &c.) is to be seen. New islands have been formed, and are filled with a dense growth of sissu and khair seedlings. There is a striking contrast in this respect between the torrents running through closed and those passing across open forest.

The tendency to form permanent beds is a direct result of decreased breadth. The water is more frequently forced over the same open course, owing to the obstruction of grass and other growth on raised portions.

As vegetable detritus is no longer burnt every year, this collects on the surface of the ground, forming mould of a high degree of hygroscopicity. Also all grass and undergrowth is now preserved instead of being destroyed. Therefore when rain falls there is a physical obstruction to the rush of water off the hill sides, and also much is retained in the mould and only given off very slowly. The consequence is that water which formerly swept over the ground and rushed down the raus in two or three hours is now discharged in about double the time.

I wrote to Mr. Ward-Smith, Executive Engineer, Northern Division, Ganges Canal, for his opinion as to the effects on the torrents crossing the canal. His verbal reply was that not having made any accurate observations, he could give no definite opinion, but his general impression is that the Ratmau nadi has longer floods and more in the same channel than used formerly to be the case.

Appended is a copy of a letter received from Mr. Palmer, Executive Engineer, Eastern Jumna Canal. It is a striking testimony to the effects of fire conservancy, since the forests to which he refers have only been closed during two seasons. But perhaps, as he suggests, the improvement is partly due to more prolonged and less violent rainfall. Only observations of rainfall in the forest could place this question absolutely beyond doubt.

In order to have scientifically accurate data as to the variation of contour and breadth of the various raus, bench-marks have been erected on both banks of all the more important torrents, and from these lines of levels will be run every year during the cold weather.

The bench-marks are each a foot cube of masonry sunk flush with the ground, and surmounted by a slab of stone on which the mark × is engraved These bench-marks are placed at the points where the raus cross the Hardwar-Khara road. They cost 12 annas each. One or two have had to be renewed, as the slabs were taken away by villagers.

In February, Mr. J. Copeland, Assistant Conservator of Forests, levelled all the raus from Khara to Maiapur, with the exception of Gaj, Binj, Rauli and Rani, which pressure of time compelled him to omit.

In order to test the variation of flow down those raus which habitually contain water for many months, I instituted a series of observations as to the dates when these raus dry up at certain fixed points. The following are the results of this year's observations :—

Range.	Rau.	Place of observation.	Date of drying up.
Western, ..	Chapri, ..	Boundary of forest, ..	11th April
	Barkala, ..	Opposite fakir's garden	Still flowing.
	Kasumri, ..	Opposite well, ..	7th April.
	Mohand, ..	„ Police Station	Still flowing.
Central, ..	Sampwala (Dholkhand), ..	Where road crosses, ..	15th April.
Eastern, ..	Rauli, ..	Opposite cliff behind Chauki.	12th February.
..	..	..	Again flowed owing to rain of 6th to 10th March.
..	..	..	Finally dried 29th March.

Natives have told me that the water recedes up the raus further and further every year. These observations, when they have been maintained for several years in succession, will help to test the truth of this statement.

The effects of fire conservancy on forest growth and reproduction I leave to Mr. Broun, as he has specially studied the subject.

DEHRA DUN :
The 5th May, 1886.

M. H. CLIFFORD,
Assistant Conservator of Forests,
Saháranpur Division.

Yours of 16th, *re* apparent effect on floods caused by your fire-protection of the western range raus.

Excepting one flood in the Ránipur rau in June, all the floods of 1885 were characterized by a lower velocity and height than has been usual for some years. I do not think we can yet be sure that this is due to the growth of jungle; it might be due to lighter showers of longer duration.

On the 8th and 9th of August we had a very heavy flood in the Ránipur rau; but instead of running full for only 2 to 5 hours as usual, it ran at full height from midnight on 8th August to 8 A.M. on 9th. This may have been due to either (1), a very prolonged steady pour discharged as usual; or to (2), an extraordinarily heavy downpour of ordinary duration which was hindered in draining off by the growth of jungle, so that its discharge was spread over a much longer period. If (2) represents the state of the case, then there was jungle enough to save us; as the same quantity of water concentrated in 5 hours instead of 8 would have breached some of our works. It is my belief that the surface drainage is already being hindered by increased jungle, but we cannot say this is the case till the observations of another season or two seasons show whether the floods continue to be of less violence and longer duration or not. If you can get the jungle thicker and, above all, get a continuous covering of stiff grass, I see no room for doubt as to the effects on floods.

For some years, the highest point of floods has lasted from a minimum of two hours to a rare maximum of 5 hours; if you have grass carpeting thick enough to hinder the drainage so much as to spread it over an extra five hours, the resulting floods will be reduced to half what they were, at the most, and the present floods would give no trouble and do no harm at all if they were halved, *i.e.*, if the same quantity of water were spread over twice the time.

But my expectation is that with another five years of fire-protection the floods will be spread over four or five days instead of coming down in as many hours.

Under these conditions, the actual quantity of flood water will be much decreased by percolation, which is very rapid near the Siwaliks: and the percolation will feed the local springs.

SAHARANPUR:
18th April, 1886.

C. G. PALMER,
Executive Engineer,
Eastern Jumna Canal.

Note.—The next two papers on the recent disastrous floods in the Punjab show that the example set by the N.-W. Provinces Government in protecting its hillsides might be followed with advantage further west.—[ED.]

JV. Notes, Queries and Extracts.

The Floods in the Punjab.—The first breach in the line is about four miles on this side of the Barara station; and three miles further on there are a series of breaks right up to the station. There is another large gap between Mustaphabad and Jagadhri, and the former station has been completely washed away. The up-mixed train, which left Jagadhri at 15-18 on Saturday, had to return to that station; and the up-Calcutta mail, due at 19-41, had to be detained there. The trolly party that attempted to pass the out English mails over the breaks was unsuccessful, and, after working all night, had to return to Umballa with the mails on Sunday morning. At first it was thought that the mails would have to be sent *viâ* Ferozepur till through communication was restored; but by the exertions of the Railway staff they were safely taken over the break, or rather breaks, on Sunday night—the Mail Agent with them. The following telegrams have been placed at our disposal by the Railway authorities. *Monday*—'English mails got through, and will catch steamer which will be detained twenty-four hours. No mails will cross to-day. Expect to get mail service into order to-morrow; breaks said to be ready. We are just starting with loaded ballast train for the breaks.' *Later*—'Line from 200' (*i.e.*, two miles short of Barara) 'to 212,' (*i.e.*, six miles short of Jagadhri,) with difficulty passable by trollies and boats; from 200, for two miles, banks and bridges down.' Later information received by telegram from Umballa states that the Markunda bridge is safe, and has been crossed by the Engineers of the line. The worst break commences at mile 201, within sight of Barara. There is no prospect of getting traffic over for weeks, but the authorities hope to be able to get the mail letters over though not the banghis. It is proposed to send the out-going mails by road dâk to Jagadhri. It is further stated that several viaducts have gone; but the report is uncertain. Boats have been available; but are no use, as the water is too shallow and the ground swampy. It has been suggested by the Engineers on the spot that the Overland mails should leave a day earlier this week, and be sent *viâ* Ferozepur. In another telegram it is stated that there is a break on the line between Patiála and Rajpur. Further and more detailed information has reached us concerning the breaks on the North-Western Railway between Saharanpur and Umballa. The part of the country in which the Railway has been damaged is peculiarly subject to inundation by sudden freshets from the hills; but in no previous instance was the rising of the water so

sudden as on this occasion. In fact, on Friday and Saturday last, the flood ran so quickly as to lead to the belief that some large body of water further up towards the hills had been suddenly released by the breaking of some *bund*. Not only has the Railway suffered, but there is every indication of a large loss of life and property throughout the district, which was for miles together completely submerged under about 8 to 10 feet of water. Luckily the floods went down as quickly as they rose; for had they continued twelve hours longer, the Engineers on the line consider that the whole Railway bank for about 12 or 13 miles would have entirely disappeared. The subsidence of the water has enabled a clearer idea to be gained of the damage done to the line. For about one-and-a-half miles, a little short of the station of Barara,—202 miles from Lahore,—the bank is practically wrecked. Throughout this length there are various gaps here and there, over which the rails are hanging in a succession of long loops. Quite close to the distant signal of Barara, one bridge of 10 spans of 10 feet each has been entirely washed out, and the girders lost. From half a mile short of Barara to 9½ miles beyond it, the damage to the line is insignificant; the only thing worth notice being that the mud buildings at the station of Mustaphabad have fallen. At 10 miles from Barara, the current of water across the line has scoured out a deep hole about 200 feet wide. The damage to the line practically, therefore, resolves itself into a mile-and-a-half of bank being carried away this side of Barara; and a large deep gap between Mustaphabad and Jagadhri. The first will be crossed by a diversion of the line with a temporary sleeper bridge, and the gap will be filled in. Both works are expected to be finished in about a week, so that through traffic may be expected to be re-opened about Wednesday or Thursday next (July 14th or 15th). Some difficulty is, however, experienced about labour, the people in the vicinity being too much engaged in saving the wreck of their own property, and looking after the safety of their own families, to find time to attend to the affairs of others. In the meantime a trolly service for the mails has been already started, the post bags being carried by elephants across the current, which is still running strongly at the site of the fallen bridge. It was at this point that one of the Native staff of the Railway unfortunately lost his life on Sunday last, being carried away by the torrent and drowned while trying to cross the mails. A trolly service for passengers will be running from to-day; but as some exposure is unavoidable, it would be as well for ladies, particularly if travelling with children, to defer their journey over this section of the line till the traffic arrangements are in a more settled state. The Markunda bridge, about which some fears have been current, is uninjured; although it is stated that the water rose very nearly to the top boom of the girders.

A correspondent who has gone down to the scene of the catastrophe writes :—'The breaks were caused through heavy rains in the low hills, which swept down over the flat country till bunded in by the Railway embankment, which is 6 to 7 feet high. The water rose to rail level, and then began its work of destruction, making channels for itself in the embankment, but leaving masses of earth here and there, which acted as pillars and supported the rails. The latter hang together by their fish plates and sleepers, rendering it possible but dangerous to run a trolly across : dangerous because in some places the rails were under water level. It took Mr. Mackinnon twelve hours to trolly the 15 miles on Sunday ; but the subsidence of the water was so rapid that Mr. Mallet did the journey in four hours on Monday. The chief breaks are between Barara and Jagadhri; Mustaphabad and Kulchi stations, between the two, being completely washed away. Fortunately no bridges have been destroyed, excepting a small iron one of ten spans of 10 feet. The rainfall must have been abnormal, as this particular portion of the line has not been damaged for twenty years. There being no rivers, but only small streamlets, there is consequently no important drainage. The Markunda rose to the bottom of the bridge girders.—*Civil and Military Gazette.*

THE UMBALLA FLOODS.—Owing to the break in the Railway line between Jagadhri and Umballa, postal communication with Simla and Bombay, Bengal and the North-West, has been retarded and dislocated. Passengers have been obliged to incur great inconvenience and hardship, and the Railway staff of the North-Western System has been exposed to a long strenuous and exhausting effort, which has not up to the present time been crowned with success. It is not only the Railway that has suffered from the mad fury of swollen currents, but the Punjab Provincial Budget will have to meet an unexpected demand for repairs to a 6-arched bridge on the Grand Trunk Road which has imitated the example of the railway structures.

When the railway between Meerut and Amritsar was under construction, the Railway Engineers with their English experience were wont to laugh at what they called the excessive waterway provided by the great Engineers who preceded them for the Grand Trunk Road. The proximity of the road to the hills was not then a condition that was appreciated at its proper value. It was, however, not altogether lost sight of, and the controversy ran hot and strong as to whether the projected line from Delhi to Umballa was to adhere to the line of the Grand Trunk Road or to go *vid* Meerut. The importance of connecting that military station with the military cantonment adjacent to the Native State of Patiála overcame the objections raised by some Engineers to crossing the line so close to the hills

over such rivers as the Jumna, Markunda and others. The subject of necessary waterway was carefully gone into, highest levels ascertained with all possible accuracy, and the various bridges were designed accordingly. The rainfall then was neither more nor less than at present. As many inches of rain used to fall between Simla and Mussoorie in 1866 as in 1886. Subject to slight annual variation, the elements for calculation were precisely similar in all respects except one. The time it took for a flood to run along its discharge course or river-bed was longer. A flood lasted longer than now; and the average quantity being then the same as now, it follows, if the floods last a less time, a greater volume of water, that is, a higher flood line and higher consequent velocity, must be the result. To that result must be attributed the failure of structures that were adequately designed 20 years ago; and the question arises: is the public to pay for the remodelling of bridges to render them adequate and suitable to these altered hydraulic exigencies—a process that has apparently no definite ending, or whether inquiry will be pushed into another direction? What is the root of this evil of many waters let loose on our road and railway embankments? The heavens have rained as hard before without causing this widespread damage. The cause is not far to seek, and inquiries must be addressed to the Forest Department. What is the condition of the forests stretching between, say, Simla and Mussoorie? Are they so clothed with trees and shrubs that the mountain flanks are a protection; is the rain retained or dispersed in infinitely numberless streams, garnered and treasured, and as it were filtered through zones of heavy obstacles? The words of the great French forester may be quoted appropriately. Surell says:—

"When trees attach themselves to the soil, their roots consolidate it and bind it with thousands of fibres. Their branches shelter it as it were a tent against the fury of the whirling rain. Their trunks, as also the fallen branches and twigs, the undergrowth and grass at their feet and that growth of weeds and other vegetation that surrounds them become so many various obstacles to small streams that otherwise would tend to unite. The total effect is to cover the soil, which *per se* is not immoveable with vegetable coating more capable of resisting erosive action of water. Besides, this vegetation divides and disperses currents over the whole surface of the soil which prevents them rushing and concentrating in mass along the watercourse lines."

But why harp on a subject that is patent to the meanest understanding? If hills, once clothed with forest, are denuded either by the axe, by fire, by injudicious grazing, or other causes, and they become bare, when our tropical showers burst upon them there is no dispersion, no absorption, no retardation—the raindrops slide over the smooth wetted surfaces of stone or uncovered soil, unite and pour headlong down into the main

currents filled to excess with a flood so incessantly and largely supplied direct from the clouds without intermediary and distributive vegetation ; and to this it is due that rivers are gorged, flood lines heighted and velocities so increased that all calculations are baffled, and in racing parlance all record is beaten.

Has this state of things been foreseen? Has the Forest Department brought forward these disastrous contingencies prominently before Government if unable to cope with the mischief itself? It is true that between Simla and Mussoorie (to designate by two well-known points a specific portion of the Himalayan ranges within which lies the drainage areas of the sinning rivers and the seat of the evil) there exists a considerable tract not directly under the Local Governments either of the Punjab or the North-Western Provinces. There are various Native States, the chief being the tributary State of Nahan, within whose territories the enactments and regulations of the Forest Department are null and void. Granted that our forest lines do not "run" within the areas where the mischief we complain of was born. What we want to know, what the public have a right to know is : what is the precise condition, from a forester's point of view, of the areas in foreign States that catch the waters the discharge of which through the railway bridges has this year cost the Indian Exchequer four to five lakhs over railway repairs, besides remissions of revenue to a considerable extent, much hardship and personal loss and suffering to riparian villagers within our own territory.

Sir, if the Bonerwals or the Waziris rush down from their mountain homes and raid our territory, carry away cattle and other plunder and fire our villages, unless ample compensation be made and the ring-leaders given up, as often as not Government is prepared to incur expenses perhaps a thousand-fold more than the property at stake in sending an expedition to chastise the offenders. Is Government in this instance going to do nothing but rebuild the bridges, and piously say it is the act of God and rest content, and with Turk-like credulity talk about *kismet*? If its Forest officers can point out the sore—can show on the map and by their reports that forest denudation has taken place—reckless felling been permitted and the once beneficent action of well-covered hills has been neutralised—then it is the duty of Government to arrest further mischief, to repair injuries already perpetrated, and insist on reboisement of the denuded areas. Surely, our Government is strong enough, and its duty clearly points to energetic action. Is a puppet Sikh Raja of Nahan or the insignificant feudatories that exist on sufferance, to be allowed, for the sake of immediate and present gains, to despoil forests that belong not to them but equally to the villagers on the plains. The inhabitants of the plains have every right to insist on the regulation of the hill forests. A source so pregnant with injury to them demands as much re-

gularisation by the hand of Government in public interests as these same interests on the Afghan Frontier postulate the expense and organisation of a strong military force against hill bandits. The same moral obligations apply. The greed and rapacity of petty hill magnates must be regulated. They cannot be permitted to allow for their personal benefit the destruction of protective forests. The consequent injury to crop and villages, and the serious menaces to the administration which prolonged breaks on a strategic and commercial line of railway present, utterly outweigh any consideration for personal interest being shown.

But primarily it is necessary for the Forest Department to show that owing to the destruction of such and such a forest certain floods were abnormally high. The public want to know has this been foreseen and Government warned about such a contingency? Has the Forest Department met obstacles: if so, how? Is it that District Officers take as usual too narrow a view of their duties, and, for the sake of the interests of one village, imperil the safety of others who are not perhaps within the District Officer's own particular territory? But it is just in cases like that where Lieutenant-Governors can make their *raison d'être* felt. Large public interests cannot be sacrificed to the supineness of any department, to the narrow-mindedness of District officials, or to the interests or prejudices of small Rajas.—SHAH-I-JANGAL.—*Pioneer.*

THE WOOD EXHIBITS AT THE COLONIAL EXHIBITION, SOUTH KENSINGTON.—*Canada.*—Prominent amongst the exhibits at South Kensington stands the timber produce of the various countries represented. Specimens of the forest growth of Canada, Australia, India, and the Cape are conspicuous in their natural state as well as sawn and polished, attracting the attention even of those who, from want of a more intimate knowledge, are unable to appreciate the important part they play in the world's history. We have heard visitors express their admiration of the beautifully polished surface of the fine log of Jarrah timber which adorns the Australian Court, and certainly they had reason, for a more splendid specimen of that durable tree could not have well been selected, and the way it has been prepared for display does credit to those who had the work to do.

It is not our purpose to discourse of the various woods in the order that they meet the eye of the visitor as he makes the range of the Exhibition, but to take them rather, one in each department, in the order of their utility, writing of those first which are in most common use. In this way our task will first embrace the woods from Canada, of which the different varieties, characteristic of the country, are artistically grouped in convenient places for inspection. It is the vulgar idea that the wooded portions of Canada form enormous tracts of dark, gloomy-look-

ing forests of pine; their sombre appearance unrelieved by any variety of tint. There never was a greater mistake made. The forests of Canada, on the contrary, are picturesque and pleasing to the eye, and in the season when the leaves begin to change the tints present many different shades and colours, lending to the woods an enchanting aspect, the same as a forest here would appear in autumn, somewhat enhanced by the majestic proportions of the trees in the Dominion.

As with us here, the pine tracts are peculiar to themselves, and whole sections of this useful tree and its near relation, the spruce, cover the hillside in dark belts, contrasting with the other varieties, forming a background which adds to the beauty of the Canadian scenery. The enormous size and straightness of the pine trees, of which these boundless fir forests are composed, we have very little experience of here. Trees of immense girth we undoubtedly possess, and our ancient oak and elms afford us specimens that often attain considerable altitude; but the huge stem of a Canadian pine of equal circumference, 80 or 90 feet without a leaf or branch, its lofty top crowned with the long and drooping fronds of needle-shaped leaves, is a sight seldom to be met with in the forest of the mother country.

There is not, of course, the same undergrowth in the timbered portion of the northern countries as there is in milder climes, but with this exception the difference in the appearance of the woods is not so marked. The forests of Canada are composed of pine, spruce, Scotch or Norway fir, oak, ash, elm, maple, birch, beech, larch, cherry, walnut, and other woods, and hardly a tree that we have named which does not come to our shores, though they do not always figure in the public sales.

Our readers are sufficiently acquainted with the merits of the white pine, or, as it is called over here, yellow pine, to need any description from us, but the various specimens supplied by Messrs. Burstall and Co. show of what a high finish it is capable in conjunction with its other preferential claims as an indispensable building material.

The chief of the timber districts, or, as they are termed "limits," of the Dominion, extend from the mountain shores of British Columbia, washed by the Pacific, containing immense forests, yielding some of the finest timber in the world, that are yet practically untouched, to the province of Ontario, the shores of Lakes Huron and Superior, the Georgian Bay country, embracing the Nipissing and Muskoka Rivers to the district drained by the Ottawa, St. Maurice, and Saguenay, to the province of Quebec and south shore of the St. Lawrence, and from the Saguenay to the Bersimis (both noted pine regions), and further on to St. John and the lower ports, where the mighty river empties itself into the Atlantic.

From this vast territory, thickly wooded with every species of timber, there is little fear of our supplies running short.

The inroads which have already been made are undoubtedly extensive to cause apprehensions of a failure in the cut of pine, but the question of forest exhaustion is still too remote to be seriously discussed at present. Many of the forests in the lake districts, Ontario and other provinces, are yet hardly touched, the land not being so suitable for agriculture, and from these regions sufficient pine will be drawn to make up for any deficiency that may be apprehended from the destruction of the older timber limits for many years to come. The importance of the forest supply of Canada to us here can hardly be estimated. Our annual consumption of pine and spruce is something marvellous, and it would be little short of a calamity if any failure took place in the forest resources of the Dominion.

We hear a good deal of the increasing scarcity of white pine, a tree which is said to be so valuable that it would be difficult to find a substitute for it were the Canadian forests to become exhausted. But this can hardly ever happen, if ordinary care is exercised to prevent destructive fires, as it will grow and flourish on the poorest soils, and is a rapid grower. Mr. Small, in his account of Canadian Forests, says that "intelligent lumberers consider that a white pine forest renews itself every twenty years." This must be an important consideration in estimating the forest wealth of Canada.

It seems that the wanton destruction of the forests in the province of Quebec was complained of by the French Governors of Canada as far back as 1696, that is 190 years ago, but the record says that "nothing was done by them to check it," and little has been done since. Is it not clear that Nature has again and again made good the ravages of man, and that still more pitiless enemy, the devouring element of fire, during the ages that have since intervened, and that she is still able to set the destroyers of her forests at defiance?

In addition to the thousand and one industries that cannot be carried on so well without the assistance of soft convertible timber, we have railways and railroads, which in the shape of sleepers, ties, platforms, stations, carriages, wagons, &c., add largely to the consumption of the forest produce.

The woods of British Columbia at the Exhibition are particularly noticeable, a large ornamental erection of pine from that country, supplied by the Hastings Saw-mill Company, Burrard's Inlet, being the first object that meets the gaze on entering the Canadian Court.

The woods from St. John were in a prominent position, a panel of each kind being scientifically arranged, the polished surface adorned with a neatly executed painting of the leaf.

We inspected the different specimens from New Brunswick, which include beech, ash, maple, birch, white and black hemlock, white pine, red pine, and balsam fir, as well as black and white spruce. Amongst the woods not generally shipped to this

country, but many of which, we think, could be used here with advantage, are the cherry, plum, bilbury, poplar, alder, hornbeam, butternut and willow, lime and basswood. Poplar is largely used in the States for a variety of purposes, and cherry is also in demand.

Ottawa, in addition to pine, is represented by neatly arranged specimens of sugar maple, red oak, figured beech, and from Burrard's Inlet, in addition to the pine specimens already mentioned, are some well-prepared blocks of red cedar and Oregon pine.

The specimens outside the court are sections of canoe, birch, tamarac, Ottawa best pine, Norway pine and red pine from Ontario, used as mining timber, the collection being sent by Mr. T. A. Keefor, of Port Arthur. There are several pieces of tamarac, black larch, aspen, poplar, of very fine and smooth grain, another variety being the jack, or scrub pine. The suitability of many of these woods for use here depends on the cost. The home-grown woods, of which these would have to take the place, are plentiful, and, unless something were gained in size or price, their introduction would not be rewarded with success. A considerable objection to the softer kinds, such as poplar, tamarac, &c., is that they will not take the plane like the pine or deal, and in that respect present a marked contrast to the non-resinous woods of the north of Europe, all of which smoothen up equally to the red or yellow descriptions.

Tamarac or hacmatac ranks with our larch or juniper, and is the most durable of all the pine tribe. For shipbuilding purposes it is considered in the United States more durable even than oak, and it is well known and appreciated at Lloyd's in their classification of ships.

It is not to be expected that, within the limits of a single notice, we can describe, even superficially, the various objects of interest in the wood department alone; and we have already occupied as much space as can be conveniently appropriated to the subject this week. What, therefore, has further to be said of this wonderful collection must be deferred to another number.—*Timber Trades Journal.*

THE

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PRIZE DAY AT COOPER'S HILL COLLEGE.

An interesting report of the prize day, on the 28th July last, at Cooper's Hill College, appeared in a recent number of the *Pioneer*, when we were very glad to see that Mr. Brandis was present. Sir Alexander Taylor, the President, in his address referred to the Royal Engineers and the Cooper's Hill men as furnishing the officers of the Public Works Department in India. He, however, omitted to mention Roorkee and the other Indian Engineering Colleges, which have turned out many very useful engineers.

The fact that, the Cooper's Hill College has this year furnished eleven officers for the Royal Engineers and Royal Artillery should assist in drawing together the men from Woolwich and Cooper's Hill.

Men for the Indian Forest Service are now being trained for the first time at Cooper's Hill; the instruction in forestry being afforded by Dr. Schlich, and the last set of men from Nancy have recently passed their final examinations with the French students, so that the long connection of the Indian Forest Department with the Nancy Forest School, which commenced in 1867, and has thus lasted for 20 years, has terminated.

Although French forestry is not always directly applicable in India, and some conservative members of the Indian Forest Department may still assert that foresters trained at Nancy should unlearn their French ideas, before they can be of practical use in this country, there can be no doubt that Indian forestry owes a great deal to France.

The magnificent oak and beech and silver fir forests of France have presented an ideal to which we endeavour to make our Indian forests approach, and though simpler systems of forest management may be more suitable than French ones for the Indian forests, yet the debt we owe to French foresters for the example they have given us in zeal for the well being of their forests, and to the *esprit de corps* of the French Forest Department, not forgetting their excellent Forest guards, can never be repaid.

Lord Kimberley referred to the forestry training at Cooper's Hill, and expressed a hope that the practical instruction in forestry might soon be given in India itself.

If such a course be decided on, and the men selected for the Indian Forest Department, after a preliminary training at Cooper's Hill, are sent to complete their course at the Dehra Dún Forest School, the latter will gain greatly in prestige and usefulness, and if besides this, a certain number of probationary Sub-Assistantships for the whole of India be thrown open annually by Government, for competition by students trained at the Dehra Dún School, the latter will then find its field of usefulness vastly increased, and the Forest Service of India will be efficiently recruited.

It is to be hoped that, in spite of a recent adverse decision of the Secretary of State, now that the Indian Public Works, Telegraph and Forest services are recruited together from Cooper's Hill, Government will raise the pensions for our Department to a level with those allotted to the others, and will insist on a compulsory contribution towards a common retiring and family pension fund, so that after having given the best part of our lives to the rough work, and frequently lonely life, of our Department, we may at least have a chance of spending the declining years of our lives in comfort, which the present full service pensions, varying from £300 to £400, at the now prevailing rate of exchange, will certainly fail to secure. Our Department has surely done nothing to deserve a lower status than the others, nor can Government wish that our controlling staff should be recruited by men who have failed to gain admission into the favored departments.

WORKING PLAN OF THE AKONA SAL FORESTS.

THE forests are of three different kinds—

1st,—High forest, though in very poor condition ;

2nd,—Coppice, or rather badly pollarded forest ;

3rd,—Fair coppice forest ;

they are principally sál.

I have divided the forests into five working circles :—

		Acres.	
(1).	Pichwari—High forest, ...	2,602	
(2).	Bariar—Pollard and coppice, ...	3,657	12,664
(3).	Takia— „ „ „ ...	4,120	
(4).	Koano— „ „ „ ...	4,887	
(5).	Balapur—Fair coppice, ...	563	
	Total, ...	15,829	

About 25 square miles ; of which 12,664 acres, or about 20 square miles, are very bad coppice.

The three forests comprising the 12,664 acres are pretty nearly of equal capacity, they are naturally divided into three portions, and are conveniently situated for supplying the different parts of the estate; thus the Bariar supplies the north-west, Takia the west and north-east, Koano the south and south-east; so that the people have not to go any extra distance for the produce they require. The forests too are, in a way, homogeneous, Bariar having larger trees than Takia, and Takia larger than Koano.

No. (1) will supply old mature timber for building, the branches and rubbish (as unsound centres) supplying fuel.

Nos. (2), (3) and (4) will supply fuel, house posts, rafters (though crooked) and stuff for miscellaneous use.

No. (5) will supply long ridge poles, dhanklies, and long straight poles.

Detailed working plans are attached.

In (1) I have taken a 65 years' rotation; the age of sál, 6 inches girth, being about 65 years, according to my calculations, but for safety's sake I have limited the cutting so that seedlings now on the ground will have 130 years to come to maturity, if that time be found actually necessary.

In (2), (3) and (4), I have taken the rotation as 30 years. This is about double the time that the present Rakhaona has taken to grow its present stock of coppice poles. There is no use in proposing a shorter rotation at present, as even the 30 years' rotation will not be able to be worked up to at first, at all events the present demand has not given hopes of it. Experience will be gained in the next few years. The past year or two's work has been interfered with by the people taking their dhankli poles, &c., at nominal rates from the unreserved forests. With a 30 years' rotation the amount of pollard stuff made available is $\frac{12664}{30}$ acres per annum, say 422 acres. But in time charcoal and poles will no doubt find a market at greater distances than they do at present: the railway will help to get a market, and arrangements should be made to get a market as long as even a trifle is made over and above working expenses, in order to get the forest into good order.

I expect a market will be easily found for the thinnings that will take place in No. (5); in another 6 years some of the forests now reserved will be giving in the strip fellings much better stuff than they yield now, and there is the Pipri forest still available.

The work was commenced in 1884, so that supposing the primary strips went over the forests in ¼ of 30 years, *i.e.*, in 7½ years, the forests would be safely worked till 1891, when it would be advisable to inspect the forest and the work done, and see if the outturn might not be increased and the rotation shortened, in 7 years. I calculate the new strip growth will

have become as high as the present forest. My experiments in other parts of Oudh confirms me in this. By 1891 the soil will have vastly improved and the growth also. The quantity of material per acre will also be much greater than it is at present.

The Bálapur compartment will not be operated on till 1886, and will take 6 years, so that the first thinnings will not be completed till the end of 1891.

It is hoped that before the three and four periodic strips are operated on many straight young poles will have appeared, and some of them can be left as standards to increase the value of the forests.

If trees for seed be desired as standards, some of the present old trees, pruned so as not to give too much shade, can be left in the third and fourth periodic strips.

The working plan now proposed is one in which I have made safety the principal object next to the improvement of the whole forests. I have had to be cautious, as I believe this is the first working plan that has been made in India for sál coppice forests.

I also add a pattern "Record," which if properly kept should show at the end of any year how the working plan is being acted up to.

When the working plan was drawn up it was not quite settled what the width of the strips should be; they were cut 16½ feet at first, and this width was decided to be adopted, but as the width of 33 feet might have been decided on, the areas worked over were in widths of 33′ × 4′ (*see* strip system for coppice printed in the "Indian Forester" for September 1885). Thus 16½ feet have been cut, and 132′ − 16½′ = 115½′ left. The forest will be worked over in this way advantageously, as the thinning will be more gradual in succession of strips in compartments detailed as on the left hand Table, instead of as on the right.

Strip System as modified for Akona								
New Fourths.	Original Primaries.	Tertiaries.	Secondaries.	Fourths.	New Primaries.	Tertiaries.	Secondaries.	Fourths	Original Primaries.
	16½′	16½′	16½′	16½′	16½′	16½′	16½′	16½′	
	132 feet.								

Wood's Regular Fourfold Strip System.				
Fourths.	Primaries.	Tertiaries.	Secondaries.	Fourths.	Primaries.
	16½′	16½′	16½′	16½′	
	66 feet.				

Mr. Townsend, the officer in charge, has kindly marked on the

maps the actual work done, and has completed the records, which are sent instead of the pattern record. The strip system for sál coppice has been also commenced in Pilibhit, and the re-growth promises remarkably well. In some rich soil we have cut in strips 33 feet broad, leaving 33 feet of forest standing, the alternate strip system. In Akona the work is done by the fasli year, which answers better than the financial year.

E. WOOD, *Captain*,

BAHRAMGHAT, *6th April, 1885.* } *Conservator of Forests, N.-W. Provinces and Oudh, Oudh Circle.*

Pichwah Working Circle (High Forest), No. 1. (*Fig.* 1).

No.	Names of Compartments.	Areas in Acres.
I.	Itaunjah, ...	671
II.	Bhagwanpur, ...	448
III.	Baraipur, ...	324
IV.	Jamnaha, ...	554
V.	Salwariah, ...	605
	Total.	2,602

Proposed rotation 65 years $= \frac{2602}{65} = 40$ acres per annum.

The strips are to be 33 feet broad (with 231 feet between the strips), therefore each mile of strip = 4 acres: this gives 10 miles of strip per annum. But till the growth be better known, and the soil is more improved for the growth of seedlings, only 5 miles of strip should be cut in any one year without reference to the Conservator.

Fellings should take place in the Itaunjah compartment, and commence 404 feet east of the junction A of the Salarpur-dih-Bhagwanpur traffic line BC and the Akona-Tandwah Mahaut line DE, and should run at right angles to the latter line.

Working eastwards, everything on the 33 feet strip should be cut flush with the ground, and the material taken out immediately, either north or south, along the strip.

The fellings should only take place between the 1st of November and the end of February, and no new strip should be cut till the material on the previous cut line has been arranged for and disposed of.

The Circle should be protected from fire and grazing.

Bariar Working Circle (Coppice), No. 2. (Fig. 2).

Order of working.	Names of Compartments.	Sub-Compartment.		Area in Acres. Tree Forest
I.	Alinagar, ..	..	..	612
II.	Barhaipurua, ..	(*a*) Barhaipurua,	395	
		(*b*) Baxaria, ..	175	570
III	Takurjot, ..	..	..	860
IV.	Samgarha, ..	(*a*) West, ..	502	
		(*b*) East, ..	445	975
V.	Rampur, ..	..	..	640
				Total, 3,657

Proposed rotation 30 years.

Area to be cut annually $\frac{3657}{30}$ = 120 acres = 60 miles of strip 16½ feet broad.

Except in compartment II., lines of export to run due north and south, as shown by dotted lines. The work, except in compartment II., always to commence on the west of the export lines, and proceed from north to south, no new work being commenced till the whole work on one side of the export line is completed. Here the export lines will be the directing lines.

The work should be done between the 1st of November and 15th March; no more material should be cut than can be disposed of.

The strips are to be 16½ feet broad, with 115½ feet between the strips.

The whole Circle should be protected from fires and grazing.

The cut produce should be removed before 15th March from off the strips.

Takia Working Circle (Coppice), No. 3. (Fig. 3).

Order of working	Names of Compartments.	Sub-Compartment.		Area in Acres. Tree Forest.
I.	Iokaha-Mangarh, ..	..	..	824
II.	Dinnamgarh, ..	..	..	1,487
III.	Bhawanipur, bank at East,	..	..	902
IV.	Bhawanipur, bank at West,	..	..	580
V.	Majhaoan, bank at, ..	..	..	327
				Total, 4,120

Proposed rotation 30 years.

Area to cut annually $\frac{4120}{30}$ = 138 acres = 69 miles of strip 16½ feet broad.

I. Work commences west of middle line CD, working from south to north, then east of CD working from north to south.

II. Run three lines at right angles to I. and II. division line from points A, H and K; run strips at right angles to these lines working from south to north.

III. Take III. and I. division line (EF) as directing line, and run at right angles to EF, commencing at E, and working from north-west to south-east.

IV. Take III. and IV. division line as directing line, and run strips to the west working from south to north.

V. Take north-east boundary line (BG) as directing line, and run strips at right angles to it, commencing at north-west corner (B) and working east.

The work should be done between 1st November and 15th March; only as much as can be sold should be cut, and the cut produce should be removed before the 15th of March from off the strips.

The strips are to be 16½ feet broad, with 115½ feet between the strips.

All the Circle should be protected from fire and grazing.

Koano Working Circle (Coppice), No. 4. (Fig. 4).

Order of working.	Names of Compartments.	Sub-Compartment.		Areas in Acres, Tree Forest.
I.	Sheopur, bank at, ...	(*a*) West (*a*+*a'*)	530	
		(*b*) East, ...	610	1,140
II.	Narpatpur, ...	(*b*) East, ...	375	
		(*a*) West, ...	430	805
III.	Misrowleah, ...	...	...	1,302
IV.	Tolidih, ...	...	...	650
V.	Kamwapur, ...	...	...	990
				Total, 4,887

Proposed rotation 30 years.

Area to be cut annually $\frac{4887}{30}$ = 162 acres = 81 miles of 16½ feet strips.

Ia. Strips to run from line *cd* west, parallel to *cf*, and working from north to south.

Ia′. Strips to run from line *cd* east, at right angles to *cd*, and working from north to south.

Ib. Strips to run from line *ce* east, parallel to *cg*, and working from north to south.

IIb. Strips to run at right angles to *fh*, and working from west to east.

IIa. Strips to run at right angles to *mo*, first to east from north to south, and then to west from south to north.

III. Strips to run parallel to *gk* running east, and working from north to south.

IV. Strips to run at right angles to *lk*, commencing at *l*, and working from east to west.

V. Strips to run at right angles to *kl*, commencing at *k*, and working from west to east.

The strips to be 16½ feet broad, with 115½ feet between them.

Work to take place between 1st November and 15th March: only as much should be cut as can be disposed of and removed before 15th March from the strips.

The whole forest should be protected from fires and cattle.

Balapur Working Circle (Coppice), No. 5. (*Fig.* 5).

Order of working	Names of Compartments.	Sub-Compartment.	Areas in Acres, Tree Forest.
I.	Balapur Rakhaona, ...		361
II.	Pipri, ...		202
		Total,	563

Note.—There must be some error in Mr. Townsend's note, or the Rakhaona has some grass patches which are not taken in the area. I have a note in which Mr. Townsend has given me the area of the Rakhaona as 361 acres, and I will work on this. It is proposed not to work Pipri in the first period of 7½ years, nor till the Rakhaona has been completed: in the meanwhile it, as well as the Rakhaona, should be protected from cattle and fires.

The growth in the Rakhaona is different from that in the three other coppice working circles. Here the stems are principally straight, though there are often too many shoots on one stool. The operation will be pruning and thinning and not a clear felling.

The working plan of the Rakhaona, with drawing to a larger scale, is given below.

Balapur Working Circle. Balapur Rakhaona Compartment.
(*Fig.* 6).

In the cold weather of 1885-86 the 8 feet line from the villages shown should be made, then the one to the south-east, and then the one to the north-east.

The sub-compartments should be worked as below :—

Order of working.	
I. in 1886.	Any suppressed trees should be removed. Where more than two stems start from one stool, any number over two may be removed, always leaving the two straightest and longest. The work may take more than 6 years, but should not take less. The work should always commence from the centre line running from village to village and work outwards to the edge of the forest, leaving off as much as possible in a line parallel to the central line.
II. in 1887.	
III. in 1888.	
IV. in 1889.	
V. in 1890.	
VI. in 1891.	

The work should take place between the 1st of November and 15th March, and all cut stuff should be removed out of the sub-compartment before the latter date.

No cut stuff should be moved through a sub-compartment that has been operated on.

The shoots when large should be sawn off with as near a vertical cut as possible, and the stump should afterwards be trimmed with an axe and present a smooth surface, so as not to let the rain lodge and affect the stool.

No more should be cut than what is certain to be sold or disposed of.

Pruning and Thinning.

Area 361 acres.

Proposed period of 1st thinnings 6 years $=\frac{361}{6}$ area to be operated on, about 60 acres a year. About 60 acres each in the areas of the sub-compartments.

The line fellings should be disposed of before commencing operations in sub-compartment I.

Record of Working Plan. Akona Forests (years 1884-85 and 1885-86).

Strip Fellings. Working Circle No. 1 (Pichwari) $\frac{\text{Area } 2602}{\text{Rotation } 65 \text{ years}}$ = 40 acres per annum = 10 miles of 33 feet strips a year.

(But until further orders from the Conservator, 5 miles only to be cut annually).

Year.		Description of strips.	Breadth of strips.	Compartment.	Sub-compartment.	No. of strips cut.	Length of strips cut.	Acres cut.	Acres up to date, actuals.	Acres to be cut up to date according to working plan	Actuals less than working plan directions.	Actual excess over working plan directions.	Remarks.
A. C.	Fasli.		Feet.				M. Fur. Ft.				Acres	Acres	
1884-85	1292	Original Primaries,	33	I.	...	8	6 5 220	$26\frac{2}{3}$	$26\frac{2}{3}$	40	$13\frac{1}{3}$	...	Strips running S. Working W. to E. starting 404 feet E. of Bhagwanpur. Salardeh line, measuring from cross roads at N.-W. corner of compartment.
1885-86	1293	...	...	I.	...	...	...	...	$26\frac{2}{3}$	80	$53\frac{1}{3}$	...	A blank year in consequence of Mr. Townsend's absence on leave.

Record of Working Plan. Akona Forests (years 1884-85 and 1885-86).

Strip Fellings. Working Circle No. 2 (Bariar) $\frac{\text{Area } 3657}{\text{Rotation } 30 \text{ years}} = 120$ acres per annum = 60 miles of $16\frac{1}{2}$ feet strips a year.

Year. A. C.	Year. Fasli.	Description of strips.	Breadth of strips.	Compartment.	Sub-compartment.	No. of strips cut.	Length of strips cut. M.	Fur.	Ft.	Acres cut.	Acres up to date, actuals.	Acres to be cut up to date according to working plan.	Actuals less than working plan directions.	Actual excess over working plan directions.	Remarks.
			Feet.										Acres	Acres	
1884-85	1292	Original Primaries,	$16\frac{1}{2}$	I.	...	138	32	1	286	$64\frac{1}{3}$	...	...	...	...	Strips running E. and W. of direction line. Working N. to S. Completed original primaries.
...	...	...	...	II.	*a*	39	9	1	165	$18\frac{1}{3}$	...	...	...	..	Strips running N.-W. and S.-E. Working from N.-E. to S.-W. Left at 18 on W. and 21 E. of base line.
...	...	...	...	...	*b*	34	7	5	440	$15\frac{1}{2}$	...	...	...	...	Strips running N. to S. Working W. to E. Completed original primary strips.
...	...	...	...	...	...	...		...		$98\frac{1}{6}$	$98\frac{1}{6}$	120	$21\frac{5}{6}$	...	
1885-86	1293	Original Primaries,	$16\frac{1}{2}$	II.	*a*	51	14	4	495	$29\frac{1}{4}$	$127\frac{1}{3}$	240	$112\frac{1}{2}$	...	Completed original primary strips.

Record of Working Plan. Akona Forests (years 1884-85 and 1885-86).

Strip Fellings. Working Circle No. 3 (Takia) $\frac{\text{Area } 4120}{\text{Rotation } 30 \text{ years}}$ = 138 acres per annum = 69 miles of 16½ feet strips a year.

Year.		Description of strips.	Breadth of strips.	Compartment.	Sub-compartment.	No. of strips cut.	Length of strips cut.			Acres cut.	Acres up to date, actuals.	Acres to be cut up to date according to working plan.	Actuals less than working plan directions.	Actual excess over working plan directions.	Remarks.
A. C.	Fasli.		Feet.				M.	Fur.	Ft.				Acres	Acres	
1884-85	1292	Original Primaries,	16½	I.	...	66	33	5	454	67⅜	...	...	...	...	Strips running E. and W. of base line. Working N. to S. Original primary strips completed.
...	...	...	...	II.	...	30	19	4	176	39 1/12	...	...	...	...	Strips running E. and W. of base line. Working N. to S. Left off at 15 on either side of base line.
...	...	...	...	...	...	...		...		106½	106½	138	31½	...	
1885-86	1293	Original Primaries,	16½	II.	...	57	41	0	0	82	188½	276	87½	...	Completed original primary strips.

Record of Working Plan. Akona Forests (years 1884-85 and 1885-86).

Strip Fellings. Working Circle No. 4 (Koano) $\frac{\text{Area 4887}}{\text{Rotation 30 years}}$ = 162 acres per annum = 81 miles of 16½ feet strips a year.

Year. A. C.	Year. Fasli.	Description of strips.	Breadth of strips.	Compartment.	Sub-compartment.	No. of strips cut.	Length of strips cut. M.	Fur.	Ft.	Acres cut.	Acres up to date, actuals.	Acres to be cut up to date according to working plan.	Actuals less than working plan directions.	Actual excess over working plan directions.	Remarks.
			Feet.										Acres	Acres	
1884-85	1292	Original Primaries,	16½	I.	*a* & *a'*	73	33	3	0	66¾	66¾	162	95¼	...	Strips running E. and W. of base line. Working N. to S. Left off at strip 39 W. of base line.
1885-86	1293	Original Primaries,	16½	I.	*a*	16	4	1	40	8¼	...	...	...	...	Completed original primary strips.
...	...	...	...	...	*b*	52	26	5	99	53¼	...	...	...	...	Strips running E. Working N. to S. Completed original primary strips.
...	...	...	...	II.	*b*	49	16	6	0	33⅓	...	...	...	...	Strips running N. and S. Working E. to W. Completed primary strips.
...	...	...	...	II.	*a*	12	1	3	275	2¾	...	...	...	...	Strips running E. only. Working N. to S. Left off at strip No. 12.
...	...	...	...	...	...	...		...		97¾	164½	324	159½	...	

THE FOREST SCHOOL AT DEHRA DUN.

FROM an outsider, and a somewhat distant one, a few remarks on the work of this institution as described in the Director's Report of the 5th course, may perhaps be acceptable to those of the readers of the "Indian Forester" as have not seen the original report, and the admirable accompanying memorandum by the Officiating Inspector General of Forests.

To quote Mr. Ribbentrop's remarks, the instruction is divided into two courses, that for Rangers, in which the instruction is given in English, and that for Foresters, in which Hindustani is used. The former course was one of 18 months, *viz.* :—

Junior Class, July 1st to December 31st, 1884,
Senior „ January „ „ „ 1885,

but in addition, a further 3 months of practical work was given, making 21 months in all. The Junior Class learnt Physics, Chemistry, Physiological Botany, Road-making, Plan Drawing and Mathematics; and spent the last two months in practical Surveying under the Superintendent of Forest Surveys. The Senior Class spent one month in completing the practical Surveying, and then studied Forestry, Geology and Mineralogy, Forest Law, Forest Protection, Mathematics, Systematic and Geographical Botany. For the Forester's course, Elementary Physics, Mathematics, Forestry and its allies, Botany and Physiography, Surveying and Plan Drawing. In all cases the lectures occupied 30 hours a week, the hours of lectures being 7 to 10 A.M. and 12 to 3 P.M.

The Senior Class of the Ranger's course spent 8 months of their 12 in the field—while on tour they were first of all, and most necessarily, taught to recognize the principal trees and shrubs met with, and to understand the chief noteworthy facts regarding them. Then they proceeded to Sylviculture proper, and were taught to understand the laws which regulate the growth and maintenance of forest crops and the habits of the component trees on which management is based. Then came the practical work of forest operations, such as thinnings for coppice, and cuttings for seed regeneration; succeeded by the works necessary for the felling, conversion and transport of timber; as well as the formation of nurseries and systems of artificial reproduction. All this part of the course was given in the field, so that the students were able actually to see the various works carried on and themselves to assist in them. On their return to Dehra the second theoretical course began, and comprised a very wide range of subjects connected with Forestry in general, ending up with the elements of working plan making. If anything, the range may be said to have been too wide, for in the writer's opinion a firmer grounding in the elementary portions and more actual practical work would be more likely to fix itself in their minds. It must be remembered that some of

the students, at any rate, on return to their provinces may be posted to divisions, where there is little more to be done than to control the issue and recovery of permits, or to measure up timber on a river; and much of the more elaborate teaching they have had may be likely to be forgotten before they obtain a charge in which they can apply it. Were we better supplied with text-books, the writer would advocate a very short theoretical course succeeding a long practical one, for the ground-work thus laid could be built upon by private study; but at present text-books are scarce, and what there are, are too abstruse for the Ranger's class, so that after all there is a probability that those in power at the Forest School are right in the end, and that the remarks made by Mr. Ribbentrop in clause 2 of paragraph 6 of his memorandum correctly appreciate the position—

"The progress which has again taken place in the development of the Forest School in every direction is remarkable and satisfactory, from many points of view; but the danger of teaching above the head of the average student at present available is not entirely absent, and must not be lost sight of. The requisite standard of education amongst the candidates for the Ranger's Class admitted to the Forest School is no doubt to a certain extent ensured by the demand of a certificate of having passed the University Entrance Examination on the English side; but, as a matter of fact, the relative knowledge, especially with regard to English and Mathematics, varies to a very considerable extent, and it becomes necessary that the teaching should be adapted to the understanding of the average student, rather than to the faculties of the cleverer and more advanced candidates."

Speaking from some experience, however, the writer would say that where our Rangers mostly fail is in the correct appreciation of facts of Sylviculture, and the experience which leads them to decide at once what to do in a forest operation.

On return from their course, they are probably able to talk and write glibly enough about the things they have heard in the lectures, but as probably fail when set down to apply them in the field. The suggestion may be made that a portion of the junior course, as well as of the senior, should be devoted to making the students familiar with forest operations of a professional character, and that more in the plains forests than in the hills, among the sál rather than among the deodar.

So much for the 'Forestry' teaching. It was supplemented by instruction in Systematic Botany, mainly in learning how to use the 'Forest Flora' so as to be able to make out the trees and shrubs met with. This is quite as it should be; but it might be suggested that, which is not mentioned in the Report, the use of the dissecting microscope, indispensable for small living and for almost all dried plants, might be added with advantage. Geology and Elementary Mineralogy, including the rough analysis of soils, were also taught. The Law course included—(i), General Law of property, possession, servitudes, &c.; (ii),

Forest Law, and (iii), Criminal Law, both General and Forest. The Mathematics embraced chiefly Trigonometry and Elementary Statics, while to it were added Plan Drawing and Surveying, the work of the Junior Class* being necessarily more elementary.

Thus it will be seen that a fairly intelligent student, who obtains the Ranger's certificate, should be competent to carry out most forest operations, to make thinnings, cuttings and valuations; to survey his forests, divide them into blocks and compartments for working, to fell, log and transport timber, and prosecute offenders. We would suggest, however, that a little more acquaintance with the preparation of estimates, and especially those for forest roads and small forest houses, such as are required by the Forest Codes, would be an advantage. But as it is, a passed candidate should be, under actual circumstances, capable of carrying out the work of a large range or sub-division, and eventually becoming a Sub-Assistant Conservator. It is important that such men should, wherever possible, be employed in those Divisions in which professional work is going on, leaving those of a routine character to their untrained fellow Rangers.

The work of the Vernacular Class seems to have been very thorough, especially in the very important subjects of Physical Geography, Physics and Elementary Chemistry.

The students who followed the course came from various provinces, North-Western Provinces 16, Madras and Punjab 11 each, Bengal 4, Coorg, Central Provinces and Burma 2 each, and Ajmere 1; while 10 were sent by the Native States of Mysore, Baroda, Patiála and Jeypore, and 4 were private students. There were none from Bombay, which is a pity, for the School at Poona can scarcely boast such a teaching staff and such appliances as can be found at Dehra.

The results were that, 9 of the students obtained the Ranger's certificate and 3 that of Foresters—and if, as may be hoped, the number of students should gradually increase—every succeeding year will see a great addition to the number of Forest subordinates capable of understanding professional work, and a vast change for the better in the work of the Department, which outsiders are frequently apt to sneer at as being 'work that any body can do.'

It is greatly to be hoped that in time this successful institution may be able to go a step further, and not only carry out the suggestion of the acting Director that young officers from Cooper's Hill might with advantage learn their language, their law and the preliminaries of their work at Dehra; but even

* During the Junior course, two months (November and December) are devoted to Surveying in the field, and the remaining months (July to October) are spent in Dehra in Plan Drawing and in the study of Physics, Chemistry, Mathematics and the anatomy and physiology of plants, which necessarily precede Sylviculture.—[ED.]

pass one of their years of instruction at that institution. There is probably neither in England nor in any British Colony, a better staff of English professional Foresters than there is at Dehra, and the instructors there should be able to instruct embryo Assistant Conservators as well as they can embryo Rangers. In conclusion, the last paragraph of Mr. Fisher's report is worthy of reproduction—

"It is evident, however, that the main object of the Dehra Dun Forest School is to train Rangers, and it is hoped that, now that well educated young men are coming forward for these appointments, the proper status of Forest Rangers may be recognized by Civil Officers, and that they may be ranked, by the authority of the Government of India, in the same position, and be treated with the same consideration, as Inspectors of Police and other public officers drawing similar pay to their own. This is far from being the case at present, and the absence of such consideration is a substantial grievance and hinders our obtaining better men for the Forest Department, the steady improvement in the revenues of which depends principally on the exertions of the men in charge of ranges."

NOTE ON BAMBOOS.*

Bamboos may be propagated either by planting out sets from existing clumps, or by sowing seed. If sets are used they should be taken from vigorous two or three year old shoots with their rhizomes, and transferred with soil about the roots to the pit in which the bamboo is to grow. The stem should be cut back above a joint at about 5 feet, and the set planted about 8 or 10 inches deep in the early rains, and as quickly as possible after removal from the parent clump. The new shoots will then be thrown up from the eyes, and, all things being favourable, bamboos fit for sale will be produced on good soil in about six or seven years. The stem may be removed and the set laid flat under the soil, as is done with sugarcane sets. This method has given good results, but the sets were regularly watered from a well.

If seed is used, it should be put down in worked earth, just below the surface, and should be lightly watered. It will throw up a shoot like grass, from the eyes of which new shoots will be thrown up during the first year. In the second year, other and larger shoots will be thrown up, and so on, each year's shoots being larger in girth and taller than those of the preceding year until the full size of the culm of the kind of bamboo is attain-

* The above is taken from a very readable little pamphlet by Colonel van Someren, Conservator of Forests, Berar, and obtainable from Messrs. Thacker and Co., Bombay. It consists of papers on Indian Forestry originally published in the "Indian Agriculturist" for 1884, intended by the author to answer, in a popular manner, the question "What do you Forest Officers do?"—[Ed].

ed. With sufficent rainfall, and in a good but not too moist a soil, bamboos fit for sale may be cut in from about seven to ten years. On poor dry land, or on sandy soils, the period may extend to twelve years or more. The seed used should be not more than a year old, and should be sown very sparsely in the bed.

The first shoot that comes up from a seed never grows into a bamboo. As already explained, the eyes throw up shoots which develope into stems. Each stem comes up as large in girth as it ever will be. It first appears as a scaly cone covered with sheaths. It then rapidly attains its full height, when the leaf sheaths at its nodes either diminish in size or gradually fall off and give place to leaves; the stem branches on its upper half, and on completion of the branching is matured. It does not grow any taller or stouter, nor does it solidify or fill up inside year by year, but stands in the clump till it dries off and dies in from twelve to fifteen years. Each stem matures under ordinary circumstances in about twelve months. A clump of bamboos of, say, twelve years of age is thus a collection of stems from one to twelve years of age and of different sizes, the variety of size being caused not by the annual increase of the older stems, or of any individual stem, but by the fact that each annual crop of shoots produces stems of greater diameter and height than those of the preceding year until the limit of the normal size of the species in both height and girth is reached. That limit may be reached in very favourable circumstances in five years, a shoot of that year coming up, perhaps, two or more inches in diameter in the first heavy rains, and rising by October to 40 or 50 feet in height. The new shoot not being branched at first is able to make its way through its companions, and, as already said, it begins branching on attaining its full height.

All that has been now written of the manner of growth applies equally to stems produced from sets or from seed. But a clump produced from seed has its normal period of life before it; whereas a clump from a set has before it only that portion of life period which had not been already spent by the parent clump from which the set was taken.

The life of an individual stem is by no means the same as that of the clump to which it belongs. Individual stems die off in from ten to fifteen years; while the common life of the clump may extend over from twenty to forty or fifty years. Some species are shorter lived than others, and the duration of the longer lived species is not accurately known, but fifty years is probably the extreme. Individual stems thus dry up and die in succession without seeding, but the clump lives out its normal period, when it flowers, seeds, and dies; all stems then living, whatever their age or size, seeding and dying together.

As each stem matures separately, and, once matured, will

never become any larger, it may be thought that when a clump has attained sufficient age to produce stems fit for sale, such culms might at once be cut out and utilized. But this would stop the increase of the clump, for it is only the young stems that are less than four years old that send up fresh shoots from their rhizomes. It thus follows that the younger stems should be left till at least their fifth year, while the older stems may be removed, for they are matured are no longer reproducing themselves and are saleable.

This peculiarity of the bamboo makes it a matter of some little difficulty to decide whether a block of bamboos is, or is not, being overworked. The condition of the separate clumps, or of a large proportion of them, must be studied, and measures must be adopted, and enforced, to prevent the reproducing stems being cut out. They are often among the finest in the clump, and often also the handiest to the axe of the cutter. They must be preserved, while if too many old stems are left, the young shoots will be hampered in their growth and become much twisted in their lower portions. Owing again to this peculiarity the closing of blocks of bamboo forest against cutters for a term of years may indeed protect the newer culms, but will also lead to many of the older ones being wasted. Each case must be settled on its own merits, but where good supervision can be enforced the closing of blocks is not advisable.

In Bengal, in parts of the North-West Provinces, in the Deccan, in Mysore and Madras, and possibly elsewhere in India, it is an article of common belief among natives and acted up to in practice, that bamboos cut in the bright half* of the month are sure to be attacked by insects, and to turn quickly to powder; while those felled in the dark half of the moon's course will last for a long time. It is also held that the new shoots are not sent up, even if rain falls, till the thunderstorms that precede the monsoon have set in; and, further, that the more the thunder, the larger will be the number of new shoots sent up that year.

COST OF FIRE CONSERVANCY IN BURMA.

THE following note has been drawn up with a view of explaining to a slight extent the high cost of fire conservancy in the Pegu Circle, and it is hoped some officer from Berar and from the Central Provinces will favour the "Forester" with information explaining the low cost of similar work in those Provinces.

* An experiment to decide this, was carried out at Dehra in 1884, and the popular theory was fully confirmed, the 100 bamboos cut in the bright moon being riddled by insect borings, whilst the 100 cut in the dark half of the month are almost untouched. It is probable that, the insects which cause the borings only deposit eggs on bright nights.—[ED].

To permit of a fair comparison of the cost of fire protection in the different provinces, the following are some of the factors which must be taken into consideration :—

(*a*). Number and area of the different tracts.
(*b*). Physical aspect of these.
(*c*). Their position with regard to villages, cultivation, rights of way through them, &c.
(*d*). Method of protection (including length and width of fire paths cleared).
(*e*). Nature of vegetation cleared.
(*f*). Cost of labour.
(*g*). Duration of hot season.
(*h*). Number of officers solely available for this particular work.

With regard to (*a*) it is clear that a number of isolated small tracts, which have to be fire-traced and watched, will cost more than one block containing the same area ; the length of outer fire paths is greater and more watchers are necessary. This is borne out by your Review (compare Bamoni Hill in Assam and the Gugamal reserve in Berar).

The physical aspect of the country affects the cost in as far as over steep ridges and broken ground the paths must be wider, the process of clearing the paths is slower, and the cost consequently greater.

Tracts distant from villages are affected ; there is the difficulty of obtaining labour and providing food as well as enhanced daily rates. On the other hand, forests surrounded by villages or cultivation, and traversed by numerous rights-of-way, are, in Burma, of which province I am writing, liable to be fired by travellers, hunters, cartmen, &c., hence an increased number of watchers is necessary.

As for the method of protection where the boundary of the forest is formed chiefly by a broad running stream, evergreen jungle or a precipitous ridge, over which fire cannot cross, the cost is nil, and although perhaps in a few places a little clearing or watching may be necessary ; divided over the whole area, the cost of this work is reduced to a trifle.

The nature of the vegetation cleared must be considered, a line cut through bamboo or scrub jungle costs considerably more than one running through low grass or high tree forest. The cost of labour and duration of the hot season are very important factors, and it is quite certain where one officer can be deputed solely to look after the fire protection of one tract, the work will be carried out cheaper and better than if he has to supervise fire-tracing of three or four, and in addition carry out girdling, collect revenue, mark contractor's timber, &c., as is the case in the Pegu Circle.

I have not the time to furnish a detailed description of the measures adopted for the fire-protection of the different tracts

in the Pegu Circle. In all there are 20 distinct blocks, scattered over the different divisions, four of these are under 100 acres in extent and consist of plantations. The work of clearing the traces, with few exceptions, is performed by daily labour (the daily rate of coolie hire is 8 annas, but occasionally amounts even to one rupee). In some forests of the Circle, this work has to be commenced at the end of December, and upon completion of the clearing, watchers upon Rs. 12 to Rs. 15 per mensem have to be entertained until the end of May or beginning of June. In only one block, Dowe, are we able to avail ourselves to any extent of evergreen forest or a broad stream. This, 31,750 acres in extent, is naturally protected upon three sides, and the fourth is cleared by the Karens, who undertake this work and the extinction of any fires for a lump sum of Rs. 100 per season. Particular mention is made in the review of Myodwin. This is a small isolated experimental teak plantation formed by Mr. Brandis some 20 years ago, it abuts on one side on a village, and on the others has fields or taungya cultivation in close proximity. A clean trace has to be kept to protect it from the taungya fires, &c., and a watcher entertained to patrol the paths. That the latter is not a luxury has been shown upon more than one occasion, when fires have been discovered inside the plantation, and which have originated therein, and when, had it not been for the watcher, the whole plantation would have been burned through.

RANGOON,
14th August, 1886.

POPPY.

WOOD FOR CIGAR-BOXES, &c.

I HAVE read the correspondence on this subject in recent numbers of the 'Forester' with much interest. I entirely agree with Mr. S. E. Peal in considering that 'tún or Poma' wood is the best we have in India for the purpose. There are of course others that will do, and among those referred to by "ex-Student" *Duabanga sonneratioides* and *Alnus nepalensis* might be used, but would not be nearly so good as several other woods that can be named, such as 'bakáyan,' *Melia Azedarach* (very like tún) and *Acrocarpus fraxinifolius*. To put down in a list such coarse woods as *Echinocarpus* and *Elæocarpus* is only to mislead.

The boxes in which Trichinopoly cheroots are usually packed are made of tún, those used in Coconada are made invariably of *Adina cordifolia*, but I doubt if that wood would be used if tún were easily procurable in the Godavari forests. I strongly advise those who want a good cigar-box wood to stick to tún, the Indian representative of the Spanish cedar, which I believe is *Cedrela odorata*.

It is worth noting here that according to the most recent determinations, neither the 'Lali' of Darjeeling nor the 'Súm' of Assam is *Machilus odoratissima*. The real *Machilus odoratissima* is the Punjab tree so common about Simla, the others will, I think, be found under other names, which I am sorry I do not yet know, when the next part of the 'Flora of British India' is published.

The three trees of Darjeeling, known to the Nepalese coolies as 'Lali,' 'Kawala' and 'Jagrikat' respectively will probably be described as distinct species, instead of being all placed, as hitherto, under *Machilus odoratissima*.

The 'Lepchaphal' has proved lately, from good flowers and fruit collected, to be not *Phœbe attenuata*, but a new species, to which Dr. King has given the provisional name of *Machilus edulis*.

I expect "ex-Student" is mixing up cigar-box woods with those suitable for tea-boxes. It would be rather too much to expect Mr. Sutherland to go to Darjeeling for such woods, when he can get tún and bakáyan from the N.-W. Provinces.

OOTACAMUND,
30th August, 1886.

J. S. GAMBLE.

GROWTH OF GRASS IN FORESTS UNDER PROTECTION FROM FIRE.

IN an official paper in the September number of the "Indian Forester" Mr. Broun says—"It is stated on good authority that in the Central Provinces under the influence of fire protection and irrespective of cover the grass becomes thinner and shorter every year until it is only about *half a foot high*." I wish this was a fact, but it *certainly* is not. During the past year the grass came up as luxuriantly and abundantly in the protected reserves as they ever did before protection from fire took place. I speak of reserves covering an area of over 1,30,000 acres in extent; some of these have been *continuously* protected from fire and grazing for 15 years, others for 10 and 8 years. The grass in very many open parts was over 3 feet high, and completely concealed the unburnt grass of the previous year.

C. P.

FENCING OF RESERVES IN JEYPUR.

AN extract on "Fencing of Reserves" taken from a report on the Jeypur State Forests by Mr. E. McA. Moir, Deputy Conservator of Forests, has been circulated for general information; but the only information given in this extract relates to the di-

mensions of the embankment and ditch, and that the average cost per mile was Rs. 100. It is obvious that this is very meagre and can lead to no useful results. What one wants to know is—the cost of labour at Jeypur—is the country flat or hilly—is the soil of clay, gravel, &c.—what is the object of this embankment with ditch—is it for protection from fires or from cattle, or from both—how many miles of it have been constructed—has it been *successful*—what is the annual cost of repairs, &c.? Unless information is given on these and other points the circulation of these extracts can do little good, and may result only in the needless expenditure of money in localities not suited for such methods of fencing.

A. J. C.

SNOW-FALL MEASUREMENTS.—In the Transactions of the Asiatic Society of Bengal for April 1886, appears a paper by Mr. H. F. Blanford on some snow measurements taken at Kailung in Ladak by the Rev. A. W. Heyde of the Moravian Mission. The object of the observations was to ascertain the relationship between the thickness of snow and the equivalent number of inches of rainfall. This was done in two ways—*first*, by cutting out with a rain gauge funnel the amount of snow on a definite area clean swept before the fall, melting it and measuring, and *secondly*, by melting and measuring that which fell into the rain gauge. The results were much more nearly similar than might have been imagined. From December 17th, 1885 to March 8th, 1886 inclusive, 70·36 inches of snow were recorded, giving, by melting, 6·40 inches of water, or 1 inch of water to every 11 inches of snow. The rain gauge was not used all the time, but from January 19th to March 8th, 5·06 inches of rain water were obtained by melting snow on an area equal to that of the rain gauge, while 5·25 inches were recorded by the gauge itself. In only one case did the daily readings differ by more than 0·05 of an inch. The previous year's experiments, not quite so accurately made, had given 1 foot of snow to 0·9 inch of water, or 1 inch of water to 13·4 inches of snow. The 1 inch to 11, is probably more nearly correct, but for rough generalities it is possible that 1 inch to a foot may be estimated.

II. Review.

IRRIGATION IN AJMERE 1884-85.

The following remarks from Mr. Whiteaway's report for 1884-85 on irrigation works in Ajmere-Merwara are interesting :—

"The character of the season has already been sufficiently indicated, poor rains in May, and the earliest part of the monsoon allowed but a comparatively small kharif area to be sown, but the spring harvest was a very fine one. Nearly all the tanks filled, a few in Ajmere, whose catchment area is small, did not fill, and the same may be said of Merwara. Jalia new tank did not fill, it depends on the tanks above it, and if they fill early in the season (which this year they did not), the later rains give a supply to it. The storm at the end of the rains broke a number of tanks in Ajmere.

"The early rains were fitful, and in August there was a long break, but the heavy storm which passed over the district in the last few days of that month and early in September, and which gave very heavy rain, especially to the eastern portion of Ajmere, will not soon be forgotten."

In the Chief Commissioner's review of last year's report, the increased quantity of water available in tanks is noticed, and it is suggested that, this is due to the policy of keeping the beds of tanks moist by not running off the water. It is probable, however, that this is hardly a sufficient explanation of the real fact that, there has been for a year or two more water available than there was formerly, inasmuch as the deliberate policy of retaining water in the tanks has only been adopted for the Bir Tank.

It is said to be due to two facts. The first is improved administration, which is due solely to the number of men now available ; the waste of water which is checked by this means is very great indeed.

The other fact is connected also with this improved administration, and was suggested by a zamindar in Merwara to account for the splendid fields of cotton grown under several tanks from the surplus water of last year where so much cotton had not been noticed before. His explanation was the strictness with which the making of beds or kyaris in irrigated land is now insisted on. This cause is a possible one, and should be investigated further, but some form of water metre is needed and they are very costly. There is another possible cause, and that is the existence of the jungles.

III. Official Papers

EDIBLE BIRDS' NESTS.

I SEND a detailed report on the collection of edible birds' nests during the past season.

On November 1st, 1885, I took charge, in my capacity as officer in charge of the Andamanese, of the monopoly of edible birds' nest and trepang.

On November 5th I proceeded in the steam barge round the islands for the purpose of examining and cleaning the birds' nest caves. The weather was exceedingly inclement, but I managed to visit most of the caves known to the Malay collectors.

The rains lasted unusually long, and on re-visiting these caves in January I found, instead of the crop of nests I expected, that the birds had scarcely commenced to build. It was not until the end of February that the collection of the nests commenced, and since that time three crops have been brought in. A fourth crop might have been collected, but it was thought better to leave these nests for breeding purposes.

The mode of collection is as follows:—

Before the arrival of the swallows, and as soon as the weather is sufficiently settled, say about the first week in November, all the caves in the islands should be visited and thoroughly cleaned, the portions of old nests and débris being removed.

After the arrival of the birds, and as soon as it is ascertained that they have built their nests, all the caves should be visited and the nests collected and brought in. The date of this visit, and indeed the number of collections during the season, is fixed by the time at which the north-east monsoon rain ceases. Being unusually late this year, we did not commence nest collecting till the end of February, but with a dry December the collection might commence on the 15th January. As the collection of nests from the present known caves takes about a month, and the swallows rebuild their nests in six weeks or so, the collectors should wait about ten days in Port Blair, and then go out again, taking care to observe exactly the same order in their rounds. The nests may be collected until the commencement of the rains, when the collection should cease, and the birds left to breed. Although the great demand is for the white nests, still it may be remarked that the fucus attachments of the grass nests, and the old nests gathered in the November clean-

ing, may be sold locally at Rs. 5 per seer, and should therefore be collected. Each collection averages about 52 lbs. of nests.

To make the collections, the following staff is employed :—

Ahyu, a free Burman, on Rs. 40 per mensem.
2 petty officers of the Andamanese Department.
3 labouring convicts of the Andamanese Department.
6 Andamanese.
1 large 12-oared boat, supplied with a mast and sail, and manned by a manji and 12 men (convicts).

The six collectors are supplied with torches, rough ladders, axes, and dahs ; also with a large clean bag lined with linen slung to the side, and an iron implement about a foot long with three prongs at one end, the other end being shaped like a cold chisel. These men detach with this implement the nests from the sides and roof of the caves, placing them carefully in their bag, from which, at the end of the work, they are transferred to a box provided with a lock.

The greatest care is necessary in detaching the nests from the caves that they should not be broken or soiled.

After being brought in to the settlement, they are cleaned and packed in circular bundles, about a foot in diameter and 4 inches thick, for export. The refuse from the cleaning should be saved and sold.

The caves at present known are :—

Passage Island, where a small quantity of the best nests are procurable, but which is only approachable in the calmest weather.
North Cinque Island, to which the same remarks apply.
Chiriya Tapu, 1 cave.
North Coast of Rutland Island, opposite Yaratan, 1 cave.
Jolly Boy Island, north side, 1 cave.
Malay Tapu, 1 cave.
Montgomery Island in Port Campbell, 1 cave on west side.
Neil Island, 1 cave on north-east coast, very difficult of approach.
John Lawrence Island, east coast, opposite East Island. The cave is hidden by a mangrove swamp.
Strait Island, South Point, 1 cave.
Passage Island, South Point, 1 cave.
South Button Island, several caves, yielding the best quality of nests.

There are caves at Rougat and at Puluga-laka-Bang.

About 3 miles inland at the north end of Stewart's Sound, large caves are to be found in a hill, from which the greatest quantity of our nests are obtained.

In Borneo, from which country China obtains the majority of her birds' nests, the better qualities of nests are found in caves in the interior, in a crystalline limestone rock, only an inferior quality of nests being found on the sea shore. These

remarks apply equally to the Andamans, and I have no doubt that when the interior of the islands is explored, that many more nest-yielding caves will be found. All our present knowledge is derived from the Malays, who through fear of the Andamanese did not dare to search the interior. The explorations should be confined to hilly country, where the crystalline limestone formation predominates. This formation is very common throughout these islands.

I have observed two kinds of swallows, both of which build in the caves. The larger bird has more white in his plumage, and builds a nest of twigs and grass, &c., glued together, and attached to the rock by a peculiar mucilaginous matter. The smaller bird builds a nest of white mucilaginous matter entirely, and it is this nest which is so much sought after.

The nest is built in the form of a small bracket attached to the side or roof of the cave, of a semi-circular form, with a radius of about 1½ inches, and regarding the matter of which it is composed opinions differ.

The swallow (*Hirundo fuciphaga*) is supposed by some to make this matter, which resembles isinglass, from a species of seaweed (fucus) resembling carrageen and Iceland moss. I have often seen this seaweed, but have never seen the birds on the seashore gathering it.

Another theory is that the bird excretes this matter from his own throat during the breeding season.

As the best nests in Borneo are found a long distance in the interior, the first theory would not seem applicable. I am unable to give any decided opinion in the matter. The natives have many theories, such as that the bird brings the matter down from the sun, &c.

In the season I have always been able to find a cave, whether on the coast or in the interior, by looking for the swarm of swallows always hovering over it. In large caves, where it is dark and torches are used, the birds and the bats, who also build there, are very troublesome.

A specimen nest is sent herewith.

The manner of cooking the nests is as follows:—They are first soaked in cold water for two hours, when they swell up, and become soft. They are then easily picked to pieces and cleaned. After this they are boiled in clear chicken broth until dissolved, a process occupying about two hours longer. The usual allowance is one nest (value one rupee) to a teacupful of soup. Any clear soup may be used. The nest is absolutely tasteless and flavourless, and I have not found that it is particularly strengthening or useful in any way.

The nests are at present sold in Rangoon, and the market there appears to acknowledge three classes of nests :—

No. 1, which consists of large pure white nests, averaging from Rs. 110—150 per viss (3½ lbs.)

No. 2, which consists of clean but slightly coloured nests, averaging from Rs. 100—140 per viss.

No. 3, being the more discoloured and dirtier nests, averaging from Rs. 75—115 per viss.

The refuse also sells at from Rs. 5—15 per one seer.

A financial return of the past season is attached. The seasons are calculated from November 1st to October 31st.

I would remark in conclusion that all the collectors, but particularly the Burman Ahyu, have worked remarkably well, and can be trusted to carry on the work.

Cash Account of the edible birds' nest industry.

		Rs.	A.	P.
Total Receipts, ...	...	4,798	14	0
Expenditure, ...	...	798	14	0
Balance,	...	4,000	0	0

PORT BLAIR;
The 15th June, 1886.

M. V. PORTMAN,
Officer in charge Andamanese.

RESOLUTION BY THE GOVERNMENT OF INDIA ON THE MEMORIAL SUBMITTED BY THE *HITASADHINI SABHA*, OF GOLAGHAT.

IN the first letter cited in the preamble, the *Hitasadhini Sabha*, while alleging that formerly all forest produce was free to the people generally, complain :—

(*a*), that the Government has recently for the first time asserted the right of the State to forest produce growing on State lands ;

(*b*), that royalties and rates have been levied on forest produce derived from State property, and that in this way even bamboos and canes have been taxed, which were formerly free to all ;

(*c*), that royalties have been imposed on forest produce growing on lands held by raiyats, both *khiraj* and *nisf-khiraj* ;

(*d*), that almost all the trees which are necessary for building purposes or otherwise, and on which the raiyats depend for fuel, have been declared to be reserved ;

(*e*), that the free salvage of timber, on which the people living on river banks depend for building material and firewood, has been stopped ; and,

(*f*), that hardship and inconvenience have been caused to the people by the constitution of reserved forests in thickly-populated parts of the country.

With regard to the first three of these allegations the Gover-

nor-General in Council observes that the practice in Assam in regard to the levy of royalty and rates is, and has long been, as follows :—

Raiyats are entitled to take forest produce, other than reserved trees, free of charge for their own use from all district forests, only paying a royalty when such produce is taken for sale. In both cases a permit from the *mauzadár* is required before forest produce is removed. These permits, which are necessary to prevent fraud, are granted free of charge in the first case, and on an annual payment of 8 annas in the second. Raiyats taking up new land are required to pay for the reserved trees growing on it only if they desire to cut them ; otherwise no royalty is payable. No royalty is levied on trees planted by the raiyats themselves, or allowed to grow after the land has come into their possession. Raiyats holding at favourable rates (*nizf-khirájdárs*) pay half the ordinary royalty.

As to allegations (*d*) and (*e*) it has been ascertained that the true state of the case is as follows :—

(*d*), both timber and fuel fit for ordinary buildings and home consumption are under existing rules obtainable free of charge from district forests when required by raiyats for their own use ; the number of reserved trees has been reduced within recent years, and few of those comprehended in the list are found within any one locality,

(*e*), inferior drift timber may be salved and appropriated by the finders, but the appropriation of timber of the more valuable kinds is restricted, the finders receiving salvage at fixed rates.

The Chief Commissioner reports that the villagers acquiesce cheerfully in the latter arrangement.

It appears from the Chief Commissioner's report that there are no newly-reserved forests in the Golághát sub-division ; and any reserve which may hereafter be formed will be constituted under the Forest Act, which requires a very detailed enquiry into all existing rights.

On a careful consideration of all the facts of the case, the Governor-General in Council is of opinion that the Forest rules are worked in Assam with the fullest leniency compatible with adequate protection of the forests from destruction, that they involve no hardship to the raiyats, that the orders to which the petitioners take objection have been in force for a long series of years, and that no sufficient ground for interference is disclosed by the petition of the *Hitasádhini Sabha*.

MEMORANDUM ON KILLING, PRESERVING AND TRANSPORTING INSECTS.

For killing insects, the best thing is a tin cylinder—say, an

empty tobacco-tin—with a closely fitting removable cap lid at each end. The ordinary half-pound tobacco tin, which is about 6½ inches long with a circumference of 9¾ inches, is a convenient size for most insects. Into this a perforated tin diaphragm may be fixed, at about 1½ inches or 2 inches from one end of the cylinder. The larger chamber will contain the insects to be killed, while the smaller one will be used as a receptacle for poison.

The most effective poison against insects is cyanide of potassium, but its peculiar property of deliquescing with either heat or moisture renders it difficult to use. I have tried making up strong solutions of it with plaster-of-Paris (calcined gypsum), but I find the effect goes off too rapidly, and the hardened cake soon becomes perfectly innocuous. I have also tried enclosing solid pieces of cyanide of potassium in plaster-of-Paris, but I have not yet succeeded in getting the plaster to set properly. Should further experiments in this direction turn out better, I hope to be able to supply a convenient form of insect poison to any one who wishes to possess it.

Hitherto, I have employed essential oil of almonds, a drop or two of which on a small piece of sponge is quite enough to fill a tobacco tin with strong fumes of prussic acid. In place of the oil, ordinary flavouring essence of almonds may be used, but its effect is not so good. The oil may be obtained from any chemist at every large station, while the flavouring essence is procurable from all provision dealers. Ordinary benzine is also very effective, and is easily obtained from any chemist. It has further the property of removing greasy stains from the wings of moths, when directly applied. Before being placed in a collection, the insect should be painted over with a fluid composed of—

1 quart of methylated spirits.
1 oz. of mercuric chloride (corrosive sublimate).
1 oz. of carbolic acid.

This will preserve it from insects and mould.

Larvæ of insects—grubs of beetles, bees, wasps, &c., and caterpillars of butterflies and moths—may be preserved in spirits of wine.

For transmission by post, larvæ may be sent in bottles of methylated spirits. Beetles, grasshoppers, and hard-bodied insects generally, should be placed in tin-boxes with saw-dust, over which benzine should be liberally sprinkled.

The various species of insects in one box may be separated by layers of paper. Lepidoptera (butterflies and moths) should be packed, with their wings together, in pieces of paper folded into triangles with the edges overlapping. The specimens must not be left loose in the box, but so arranged that they cannot be shaken in transit. When packed with insects, the box should have all its interstices covered with gum paper carefully applied, so as to exclude all enemies.

M. H. Clifford.

JV. Notes, Queries and Extracts.

Shall we look after our Forests?—Another report has just been published from the Select Committee on Forestry, of which we gave some account last year (see *Timber Trades Journal*, Vol. 19, p. 143), with extracts from the evidence obtained at the several meetings of the Committee; which appears to have commenced its sittings this year on the 19th of May, and terminated them on the 18th June, after four attendances, *viz.*, on the 1st and 4th of June, besides the first and last meetings. Sir John Kennaway was chosen President, but on two occasions he was absent, and Sir John Lubbock was called to the chair in his place.

The following draft report, agreed to at the final meeting, summarizes the Committee's labours up to date, and, with possibly the best intentions on the part of the members, it is not easy to discover that anything definite has yet been done to promote the objects for which the Committee was appointed; that is, to determine whether a college or school of forestry was necessary, and if so, where to establish it. What has yet been done amounts to no more than this:—

"Your Committee have taken some evidence upon the matters referred to them; but have not had sufficient time to conclude their investigation, on account of the dissolution of the present Parliament. They have, therefore, agreed to report the evidence already taken to the House, and to recommend that a committee on the same subject should be appointed in the next Parliament."

Colonel Pearson, who was one of the principal witnesses on the last occasion, was first re-called and re-examined, as a man of great experience in the forestry of India and in France. But, as he gave a very full explanation on the former occasion, his evidence was not much more than a recapitulation of what had already been published. In answer to questions put by Sir John Lubbock, he gave a full account of the state and requirements of forestry as a practical and useful study, likely to be beneficial to the country in improving the growth and quality of its timber. He insisted a good deal on the necessity of any school of forestry being contiguous to some forest, to which the pupils should have free access for the purpose of obtaining practical knowledge; and when under examination by Dr. Farqu-

harson, he said, in answer to an inquiry, if there were any forest near Cooper's Hill, to which the pupils there could be taken—

"No! That is precisely what I wished to convey by my evidence. To my mind the instructions now given at Cooper's Hill will be thrown away, unless a tract of forest is provided, handy, to which pupils can go. I do not see how it can be carried on without it."

It appears the Crown has plenty of forest land near Cooper's Hill, and the want may be supplied if the authorities can be propitiated on the subject; at least, certain privileges might be accorded to pupils of the School of Forestry, to perambulate the forest for the purposes of instruction, and under proper regulations. Col. Pearson answered interrogatories from nearly every member of the Commission present, *viz.*, Sir J. Lubbock, Mr. Chas. Acland, Dr. Farquharson, Mr. Northcote, Mr. Biddulph, Sir George Grant, Sir E. Lechmere, and Mr. Mark Stewart, and he gave a great deal of information which spreads over about fourteen folio pages of the thirty-nine which the report comprises. Much of it related to the larch, its liability to diseases, and how to counteract them, for which we must refer the reader to the report itself, which is printed by Hansard, and may be had of any bookseller for sixpence.

The next who presented himself for examination was the Rev. John Crombie Brown, LL.D., also a great forest authority, well known as an author of books on the subject. In answer to Sir J. Lubbock, he gave a circumstantial and comprehensive account of a course of forestry extending through the varied seasons of the year, and was zealous for a very liberal education being given to forest pupils, including practical chemistry, engineering, geology, agriculture, political economy, conveyancing or bandaging and surgical appliances, and animal physiology.

"I may add (he says, p. 16) that in connection with the above studies I would advise that a course of instruction should be given in forest botany, in forest mycology, or the study of fungi, in forest entomology, in forest ornithology, and in forest mastology."

"The Lord deliver me from Sir Harry Vane!" exclaimed Cromwell in forcibly dismissing the Long Parliament, and we imagine some such ejaculation would be likely to escape the unfortunate pupil's lips in reference to Mr. Crombie Brown, LL.D., if his curriculum, with all its mysterious "ologies," were inflicted on him. Even the interrogating Commissioners must have raised their eyebrows at the "words of learned length and thundering sound" which flowed from this learned gentleman's tongue as easily as if they were only monosyllables.

"And still they gazed, and still the wonder grew.
That one small head should carry all he knew."

Dr. Farquharson seemed to think such an education as the reverend gentleman had suggested could hardly be commonly required, for he said—

"This elaborate course of study, that you suggest, I presume was only for those foresters who are to be employed abroad in public works?"

Nor does the answer altogether satisfy the reader of its necessity.

"My view is (says the Rev. Mr. Brown, p. 17) that the students should be trained as students, and, if necessary, fitted for any employment in India, and the Colonies, or at home, for their being thoroughly qualified scientific students of forestry, with the full knowledge of the practical application of the science."

Asked how he would deal, in his educational system, with the class of foresters "to whom we pay eighty to a hundred pounds a year," he was of opinion that if the suggestions he had made were followed "they might attend one year or more, and arrangements might be made for giving them instructions in the evening, so that they might support themselves by working in the nurseries in the neighbourhood of Edinburgh," &c. All this heap of knowledge to be crammed into the head of a man who is to support himself by "working in the nurseries of Edinburgh" (if he can get the chance), where, of course, he would be under the orders of a superior, who would require him to follow directions, and not to parade his scholastic acquirements, for which there would be no occasion. Nor is it always a recommendation to employment that you know more than your master. The unlettered day labourer can be trusted to do the work he is used to in a workmanlike manner. What more can the manager require? The well-taught man is, however, to be preferred, according to an old Latin precept which we learned at school. The acquisition of useful knowledge, as a rule, soften the manners. *Nec sunt esse feros.*

Dr. Brown's theory was quite opposed to that of Col. Pearson, who thought an intelligent practical forester, would learn almost all that was necessary in about as many months as Mr. Brown would give him years. Questioned by Mr. Mark Stewart as to the waste going on abroad, whether he thought the value of wood likely to increase in this country he answered—

"Much will depend on the value of iron, and the extent to which it can be used instead of wood. One reason why so little attention has been given to scientific forestry in Britain, as compared with the Continent, is that we have fuel apart from wood at command, which they have not. We have timber brought from all countries, and valuable woods from all nations freely introduced, and therefore there has been no necessity for the same amount of attention being given to the subject here."

In illustration of the expense of transport he asserted that at the Cape of Good Hope they could get timber cheaper from the

Baltic than from the Table Mountains, just at the back of their city.

Mr. W. Schlich, Ph.D., was next called in and examined. This witness is Inspector-General of Forests in India, and of twenty years' experience in forestry. He was not of opinion that the supply of timber to this country would fall off very rapidly, but he thought that "the supply from Canada would run short before that from Russia and Norway." This gentleman also went through a long examination, and gave his replies in a very distinct and direct manner. His opinions on practical forestry and the necessary education for it coincided more with those of Colonel Pearson than with the Rev. J. C. Brown's. Our limits warn us that we can only afford him an extract or two. Asked by Dr. Farquharson if the demand for timber was not diminishing in this country (question 323), he said—

"It certainly did not occur to me that the imports were falling off, and, as for the home produce, I think it is only possible to make a very rough estimate of what it comes to. The value of the home-grown timber has been estimated at £3,000,000 a year."

Then it was suggested that iron was largely supplying the place of wood for ship-building?

"Yes! But at the same time a much larger quantity of iron and wood together is required than was required twenty years ago."

Nor did he think that if railway sleepers were to be made of steel and iron, the demand for wood thereby would appreciably decrease.

"It strikes me that the demand for wood and iron would increase at the same time."

Asked about Stettin oak, he said that was a very general term. It might come from that quarter, but where it exactly comes from is quite problematical. He gave no opinion as to its comparative value with English oak. He thought that which grew slowest would be the best. An opinion which has been combated in our columns. When told that there was a large quantity of English oak ready to come into the market if the price rose, he replied, "If the owner of oak timber is waiting for that, he may have to wait some time." It was admitted that Stettin oak was much more in demand than English for railway purposes, and the reason is, no doubt, that it is cheaper, straighter grown, better prepared for market, and converted to immediate use with much less waste.

For ships' timbers the preference would lie the other way. This gentleman's evidence occupies thirteen folio pages, and was elicited by inquiries from almost every member of the Committee present. After him, at page 33, Mr. Julian C. Rogers was called in, a member of the Surveyors' Institution, which is a purely examining body. He was of opinion that the forests at

home and abroad were going to decay, and he had no hope of the lands being re-afforested by the owners, and that Government ought to take up the subject as a purely national question. One statement he made which strikes one as quite at variance with common report, if not with common sense. It is only within the last twenty years that British Columbia has been thought of as a timber-exporting country, and its forests are still spoken of as almost impenetrable and inexhaustible; yet in the answer to question 450, put by the chairman, he said:—

"It appeared that in the colony from which we could hope to obtain the largest supply of timber, British Columbia, *all the timber in accessible situations has been cut and exported.*"

We have italicised the last part of the sentence because the revelation is so astounding. We are still obtaining the bulk of our American timber from Canada, whence we, and indeed Southern Europe generally, have been taking large supplies for the last century, and the demand even now is inadequate to the supply. Where, then has all the accessible timber of British Columbia gone? It does not pay to send it here.

Mr. Rogers thought a three year's residence at College, as part of the training for land agents, impracticable, and out of the question, whether at Cooper's Hill or at Edinburgh, and he adds:—

"The most that could be done for them would be to institute a system of lectures; and I venture to think that lectures in London in the winter on purely theoretical subjects, and a course of lectures on Saturday afternoons in the summer at Kew, with one or two excursions for the purpose of practical instruction, would meet all requirements, but residence is totally out of the question."

Such are the opposing opinions of great authorities!

The examination of Mr. Alexander Mackenzie, the Director of Epping Forest, which terminated the business done by the Committee, was very brief, and we have only room for his concluding observation, in reply to Sir Edmund Lechmere (question 528 and last), as to whether he found (through this indifference of landlords) a want of intelligence on the part of wood bailiffs?

"Yes, I do, very great indeed, I have very seldom been able to stir up anybody's attention to the management of timber. I may be an enthusiast; but I think those gentlemen who do not take it up miss a very great pleasure, and can have no idea what is in store for them."

The impression left on the mind of the reader after going through the report is, that all the earnestness on the subject of schools or colleges of forestry is limited to professionals. The outside public, including even landlords themselves, cannot be aroused to any enthusiasm on the question; and we fear that apart from India, to which may now be added Burma, where

English experience in timber would be appreciated, chiefly as knowing the marketable values of the forest produce, these forest students would not find many localities eager to give them a living salary for their scholastic acquirements after all.

If Government saw fit, in so good a cause, to introduce an Act to require every land-holder to keep a certain portion of his property under forest cultivation, then able foresters would come into demand. Short of that, we fear the *locus standi* of forestry and foresters has yet to linger long ere it will receive any important elevation.—*Timber Trades Journal.*

INDIAN FORESTS.—On 16th July an interesting meeting took place in the Conference Hall of the Colonial and Indian Exhibition when Dr. Brandis, C.I.E., F.R.S., late Inspector General of Forests, gave a graphic description of the forests of India, and a review of the system which has been adopted during the past forty-five years to prevent the destruction of the timber and resources of the native woods. Mr. R. B. Chapman, C.S.I., occupied the chair, and amongst the audience we observed Mr. Baden Powell, Dr. Cleghorn, Colonel Beddome, Mr. Drysdale of the Indian Forest Service, also Sir George Birdwood, General Frederick Cotton, General R. Maclagan, General MacLeod Innes, General Crofton, R.E., Dr. Thornton, Mr. Farmer, late of New Zealand, Mr. Wardle, Mr. Simmonds, Dr. William Markly, of Oxford, and many others.

Dr. Brandis then read the following paper :—

India of the present day is entirely different from what it was forty-five years ago. Some of the most important provinces have since that time become incorporated with the British Empire. Not including the recent acquisition of Upper Burma, an aggregate area of 270,000 square miles now inhabited by forty-one millions of people has since 1840 been added to the British Indian Empire. A network of telegraphs, roads, and railways has brought about a revolution in the trade, and in the whole manner of transacting business and their rapid means of locomotion are working quickly a complete change in the habits of this populous but formerly slow country. Canals and other irrigation works have brought under cultivation several millions of acres. At the same time internal customs lines and other obstacles to the free interchange of products between different provinces have disappeared, the duties on both import and export trade have been removed, and the value of the external trade has during this period increased more than sevenfold.

To the observant traveller whose experience of India has not been limited to a cold-weather tour by steamer and railway, or to a few weeks' shooting in a comfortable and well appointed camp, one of the most remarkable of the many changes which India has undergone during this period has been the rapid ex-

tension of cultivation within the British territory. Over entire districts the forest has been cleared, and vast areas of formerly dreary waste have been converted into smiling fields and productive gardens. At the same time, the demands of wood and timber for the construction of railways and other public works have caused a destruction of the forests during this period which has been most remarkable.

India was probably not originally, like Northern Europe a forest country; the drier provinces of North-Western India were probably always bare and without forest; and in the extensive and densely peopled plains of Northern India, the forest had probably been cleared several thousand years ago. But a large portion of the country has a moist climate, and is hilly, and in the moister districts on the hills and in some places in the plains, there were forty-five years ago and there still are large areas of forest, but since then the forest has everywhere been broken into by the extension of cultivation and by the rapidly increasing demands of railways and other public works.

In the British Isles, the number of species of indigenous trees is about thirty; in India there are considerably over 1,500. But among this large variety there are only about a hundred that are in general use. In a warm climate like that of India, timber decays rapidly, or is attacked by insects, and only those few kinds are in general use which are durable, and otherwise suitable to be worked, not too hard or not too heavy. Naturally the demand has always been greatest for the most valuable kinds. The foremost of these is teak, the king of the Indian timber, and thus it came to pass that as long ago as the commencement of this century, measures were taken in order to preserve the natural resources of this valuable timber. Effective measures on a sufficient scale, however, were not taken until the rapidly progressing destruction of forest and timber in more modern times showed the necessity of such action.

The system which has now been adopted in this matter is to select suitable areas of forest lands which are at the disposal of the State to constitute them State Forests under the Forest law; to buy off or to commute by the grant of land any rights which the population in the vicinity may have in these lands; to mark off on the ground the boundaries in an unmistakeable manner; to place these areas under effective protection; to improve them by sowing and planting wherever necessary; to open them out by roads or by the improvement of water communication, and to arrange cutting, and the work generally by a systematic plan of operations. These State forests now aggregate thirty millions of acres, which is about 5½ per cent. of the total area of British territory in India.

The primary object of these measures is to maintain a permanent supply of timber and charcoal and other forest produce, and the sale of this produce yields at present an annual revenue

to the State of over ten millions of rupees, of which revenue, however, two-thirds are expended upon establishment, upon planting upon roads, and upon other works of improvement, so that the net income from these estates amounts to only about 3½ millions of rupees. These State forests, however, are expected to do a great deal more for the people of the country than to provide a permanent supply of wood and timber. During seasons of drought and famine, which, unfortunately, owing to the peculiar climate of India, occur from time to time, and to which the country will probably always be liable, the chief difficulty generally has been the mortality among cattle. Grain can be carried long distances to feed the people, but the carriage of cattle fodder in sufficient quantities is difficult. The cattle therefore either die, or must be driven away to distant districts. In the drier parts of India grass grows more plentifully, even in exceptionally dry seasons, under the partial shelter of trees and bushes. In some of the Rajputana States, the forest reserves which the Native Chiefs had ages ago established chiefly for shooting, are, in times of drought, opened to the cattle of the surrounding country, they feed upon the grass, and to some extent also upon the branches of the trees, and bushes, and much mischief and suffering are prevented thereby.

Acting upon this experience, State forests to the aggregate extent of 89,000 acres have been established in the adjoining British district of Ajmere, and the grass which grows up abundantly under protection on these areas has already on several occasions furnished a most welcome supply of cattle fodder to the villages in the vicinity of these forests. For similar purposes have State forests been formed in some of the drier districts of the Deccan and of North-Western India, and this is the commencement—very small as yet—of a measure the future importance of which it is difficult to estimate.

How far the protection and improvement of these large forest areas may have a favourable effect upon the climate of the drier regions of India, of those which are most exposed to drought and famine, we are not yet able to say, but it is certain that the improvement of the forest has in many instances done good already in affording shelter against hot scorching winds, and the dew has increased in their vicinity. Nor are indications wanting that in a hot climate like that of India, the forests will eventually have the effect of lowering the temperature in the hot season, of increasing the atmospheric moisture in their vicinity, and possibly of augmenting the rainfall. These, however, are as yet uncertain and problematic results, and in framing the measures of forest policy, they ought not yet to be taken into account.

Certain, however, it is that hilly countries and especially in countries where, as in India, the rain falls at certain seasons only, and then falls in excessively heavy showers, a covering of forests

protect the soil from being washed away, and prevents streams from silting up and fertile valleys from being covered with sand. In this respect denudation has already done much mischief in India, and such mischief can only be prevented by the protection and establishment of forests.

There is no doubt, moreover, that the surface drainage and the water supply of rivers in hilly countries is best regulated by forest growth, and that irregular floods in rivers are to some extent diminished thereby.

The management of thirty millions of acres of State forests demands a large staff of officers. The majority of these officers are natives of India. Europeans are employed in a comparatively small number only of the superior appointments. The backbone, so to say, of the Indian forests staff will, when the organisation is completed, eventually be the forest rangers, the officers, with whom rests the executive management of the forest estates, and who have the control of the forest guards, and the other protective officers. In order to give to these forest rangers, who are all natives of the province where their forests are situated, the needful and scientific and practical training, a central forest school has been established at Dehra Dun, at the foot of the Himalaya; and a large extent of forest, situated both in the hills and in the plains, has been attached to it, to serve for the practical part of their instruction. Had the organisation of the forest business in India been completely carried out there would at this time be upwards of 1,500 forest rangers in all the provinces.

In this manner, and mainly through the teaching at the Dehra Dun Forest School, it is hoped that forestry, which originally was an exotic introduction, will eventually become the property of the people of India, and will be developed by them for the benefit of their country.

The directing and controlling staff consists at present of about 170 officers, and is not likely to be much increased. The intention was when the organisation was framed, that really first-rate Native forest rangers might earn their promotion to the directing and controlling staff by distinguished service as rangers, and this plan will doubtless be carried out. At present the superior staff is recruited chiefly by young Englishmen, selected on the ground of an examination in mathematics, English, and the elements of the natural sciences, who receive a special training in forestry before they are sent out to India.

The manifold objects aimed at by forest conservancy in India cannot be accomplished by the establishment and good management of State forests only. As forestry becomes, so to say, naturalised in India, it may be confidently expected that the forests in feudatory States and those of private proprietors, will be managed on a plan similar to that adopted by the State in a portion of the forest land under its control. And it may also be

hoped that communal forests, the property of villages and municipalities of towns, may hereafter be established on the model of the communal forests in France, Germany, and other countries of Europe. No institution will better receive a healthy development of self-government of local bodies than the formation of such communal forests.

In this respect the Forest School at Dehra Dun will be invaluable. A commencement in this direction has already been made, for the Chiefs of several Native feudatory States—Patiala, Jeypore, Baroda, and Mysore,—have already sent young men to Dehra Dun to be educated for the forest service in their States.

A collection of water-colour sketches, illustrating Indian forest scenery, were exhibited, and explained by Mr. B. H. Baden-Powell, B.C.S., C.I.E.—*Allen's Indian Mail.*

THE BIG TREES OF CALIFORNIA.—I heard about the big-trees of California when I was a small boy, and I used to wonder at the stories of people riding on horse-back through the fallen trunk of one of them. The wonder is not lessened when one gazes in reality at these giants of the forest. The trees are called by their Indian name of sequoias, and the region where they grow is due east from San Francisco, among the hills on the western slope of the Sierra Nevada, the eternal snows of which are plainly in sight. The elevation at which they grow is about 4,000 feet, and they grow in the midst of thick forests of pine, with oaks and evergreens and creeping plants and undergrowth in great luxuriance. The hill-sides are crossed in all directions by streams of the melted snow, and many creeks and torrents, which, in connection with the matchless climate of this part of the world, make a ramble among the woods more enjoyable and less fatiguing than anywhere else I know.

There is shooting and trout-fishing in abundance to be enjoyed among these hills, and it is one of the few regions where the grizzly bear may still be encountered, but as the monster is cunning and quick of hearing, and there are no beaters to make hunting easy, as in India, the favourite way of shooting him is to wait at night in a tree near where he goes to drink. The first and more difficult thing to do, however, is to find his trail, and if the tracks are fresh, and the hunters impatient and venturesome, he is followed up at once with dogs which bark at his heels, and delay his progress till the hunters come up. The puma, otherwise called the American lion, or the cougar, is common there, and although Captain Mayne Reid has described it as a fierce and dangerous beast, it is in truth as cowardly as the hyæna. But the large game which is most sought is the black-tailed deer, while small game of many kinds is almost unlimited. The tufted mountain quail is to be seen in every glade of the forest, and has a beautiful blue-gray and speckled plum-

age. The trees are full of gaily coloured birds, one of the commonest and most remarkable of which is a black and white woodpecker, which has the flight of a bulbul, and occasionally catches an insect on the wing. Many trees are perforated all over the trunk with the holes made by this indefatigable bird in its search for food, and it treats the telegraph posts in the same unscrupulous manner, believing, from the singing of the wires, that they must be full of insects. Fortunately for all who like to see natural wonders best as God made them, that region of superb scenery and big trees is not yet accessible, even from the nearest point of railway, except by a journey by stage-coach of at least sixty miles, and the total cost of the trip from San Francisco or Sacramento city is about eighty dollars to each person. Consequently the class of people to whom a big tree means so many cubic feet of timber, and a hillside as a nasty place with no road, keep away from it.

The sequoias are found in four or five groves, within the compass of three counties, Calaveras, Mariposa and Toulumne, and they are much more numerous than most people suppose. One grove contains 93 trees of immense size, and another 1380, and giants among these have a diameter of 30 feet and upwards. Unfortunately vandals have left their marks all about the small fry, carving their miserable patronymics in every place of majesty, and the bigger folk hewing passages through two of the mighty trunks for carriages to pass under, and even cutting down one of the vastest trees that they may build a roof over the stump and dance and hold concerts and other funny things upon it. They had also the unspeakable audacity to construct a bar-room, and a bowling alley 81 feet long upon the prostrate trunk; but visitors did not drink and play enough to keep up the cost, so the almighty dollar dissipated that place of foolery.

Nobody has the slightest idea how high 323 feet looks when it is at the top of a tree. The first sight of one of these enormous sequoias is almost stupifying. What it is and how came it there, are questions the beholder asks himself. All round are immense pines 8 and 10 feet thick, which would attract notice anywhere else, but they look like saplings when Old Dominion or George Washington stands up besides them. You take a position at the base of the tree, and look up as far as the eye can see through the branches, and you realise that you are looking higher than the top of the tallest cocoanut or tamarind. Birds are hopping about like grasshoppers, safe out of gunshot. Yet you see with amazement that the trunk up at that height is still 6 feet thick. Then you fix your eye on some mark and step backward, and there all above the mark are the dimensions of an ordinary huge tree with great boughs reaching towards the sky, till the topmost branches wave their leaves at a lofty eminence where no other green thing was ever near. Then you look down at the trunk. Thirty feet in diameter! As wide

as a small house! Thick enough to fill up a street! Large enough for two omnibuses, to stand behind! Ninety feet in circumference! Still that is not an extreme size. "Ohio" is 104 feet in circumference, and "New York" is 106 feet. The height of "General Garfield" is 340 feet, and "Starr King," the tallest of all, is 366 feet high.

The trees may next be examined as they lie down; for during the twenty centuries or so that they have been growing here the lightning has split them, and forest fires have burned great holes in the sides. There is one standing in "Big Tree Grove," with its trunk hollowed out to a height of 90 feet, and another in "South Grove," where 21 horsemen have stood together in a burned and blackened hole in its side. The great pines beside them are a thousand years old, but they have grown up from the seed since the fire was there, and do not show the faintest trace of the flames. Since the fire, the force of storms, and the weight of snow in winter have strained and twisted and snapped many of the burned sequoias which have crashed down upon the earth, shivering 6-foot pines into splinter, and clearing a great gap in the forest. I paced along the round and smooth trunk of one of these fallen monarchs, mounting it with a ladder, and felt that a slip of the foot would give me as severe a fall as if I fell from branches of another tree. "The Father of the Forest," bigger than any tree now standing, lies along the ground for 300 feet. It is 112 feet in circumference at the base, and at the other end, where the top has been broken off by falling against another tree and has mouldered into dust, the diameter is still 11 feet. At least, that is what I make it, the guide-books say 16 feet. I spent a long time inspecting this prodigy of the vegetable kingdom, and each time I went from one end to the other the walk was 100 yards. Imagine a single log of that length and 11 feet thick at the thin end! About the middle of the tree there is a piece, a mere piece, 30 yards long, which has been so well hollowed out that I walked through it without stooping, and was sometimes barely able to touch the surface above my head. You got into this strange tunnel at a place where the side of the tree has been broken, and you get out of it through the hole left by a natural knot in the wood. This knot hole has not been widened or interfered with in any way, yet I climbed up a step-ladder inside of the level trunk, and crept through it without touching it with my shoulders on either side.

I stop here, not for want of more to say, but because it is time to stop. But to avoid a common mistake of descriptive writers who are apt to write pages about something they have seen, and yet not tell what it is like, I will add that a sequoia tree has the general appearance of a cedar, and is perfect in its stately symmetry. The stem is very straight, and the thickest branches are about the middle of the tree, but they do not spread

out much. The leaves are small and like cedar leaves, and the cones are a little larger than a walnut.—BENJAMIN AITKEN.—*Christian College Magazine.*

THE WOODS IN THE EXHIBITION.—Tasmania is not represented in the exhibition. They were having one of their own at home, and the Colonial Government granted them £2,000 towards getting it forward, in return for which they have given up the space allotted to them at South Kensington, which was badly wanted.

New Zealand, therefore, with Fiji, represents the remaining British possession in the Southern Hemisphere. In this Court, which is not an extensive one, the timber shown embraces some splendid specimens of the Kauri pine from Auckland. This tree, from which the gum exported during five years amounted to 28,000 tons, of the estimated value of £1,480,000, grows only in the northern part of the island. It is already well known here, and for many purposes has a special value of its own.

It came in for mast purposes when wooden spars were more common, like Oregon pine, to which it bears some affinity, but the cost of importing is with this, as with the Australian woods, the great drawback to its more frequent use. That it has immense advantages over the ordinary pine genus in the way of durability is undoubted, but, on the other hand, it is not so soft, and for ordinary building and carpentering work cannot compete with the woods in the Northern Hemisphere. About 3 feet diameter is the average growth, though some trees have been felled going to 5 feet or more. From Wellington the *Dacrydium cupressinum* (Rimu), seems to be a wood of some figure, but the specimen exhibited is not at all a good one. The *Podocarpus*, another species of pine (Totara), is straight in grain, but has not any special feature to recommend it to users on this side, although it is one of the most generally used in the colony. The *Podocarpus totara*, from Wanganui, is a better figure, and appears to make good furniture, judging by the display in this Court. The *Metrosideros lucida* (Rata), also from Wellington, is a wood in colour like the American walnut, but of a much harder nature and closer grain.

The *Vitex littoralis* (Puriri), Auckland, is another of the hard-woods which we think might be introduced here with advantage. It has a splendid figure, and in that respect vies with the deeper coloured walnuts of home growth. There are several descriptions of light straw-coloured woods of large dimensions that would make capital bedroom furniture if they could be imported in sufficient quantity and at a moderate price. Of these the *Podocarpus dacrydoides* (Kahikatea), from Wellington, affords several nice samples, but the quantity is not sufficient for doing a large export trade.

A fine plank of the *Podocarpus spicata* (Mataii), from Wanganui, of straight grain and sound, with knots a very insignificant feature is one of the group forming the trophy of the woods of native growth which presents a central object in the New Zealand Court.

The whitewood *Dammara Australis* (Kauri), from Auckland, is a fine figured plank. We have not space to enumerate all the varieties of the pine genus. The woods are best seen in a manufactured state, and some magnificent specimens of doors of Kauri and other woods, with pedestals, and specimens of mouldings, &c., are supplied by Messrs. Halley and Ewing, sash and door manufacturers, of Courtney Place, Wellington.

Another highly finished specimen of wood-work is supplied in the shape of a magnificent sideboard, table, chairs, and sofa, of the various woods. The table is made of Rimu, of beautiful wavy grain, not unlike cypress, but of a deeper colour, and, considering its excellent finish, is put at a comparatively low price; these are manufactured by the Dunedin Iron and Woodware Company.

On the opposite side of the Court is another exhibit of furniture, embracing a beautifully inlaid table, as well as wardrobe and cabinet, besides a handsome chest of drawers.

A very unique ornament is presented in the shape of a view of the harbour of Wellington, with the shipping, &c., composed entirely of native woods, and said to be a very good representation. The cabinet and wardrobe is manufactured by Messrs. Garlick and Cranwell, of Auckland.

Mr. C. E. Best, of Wanganui, exhibits some of his own manufactures, a sample of which is shown in the inlaid table already alluded to. There is an oval dining-table of excellent make, composed of different varieties of wood in the Colony, showing the various leaves of the trees used; in fact it would be difficult to find its equal, both for workmanship and solidity.

Amongst the woods used affording fine figure and variety of colour are white pine, Totara knot, bog Totara (the latter almost black), moire, mottled kauri (like the cypress), puriri, red pine, and honeysuckle, a wood with a figure like nutmeg, and something similar in colour.

Cousins and Atkin, coach-builders, exhibit a landau built of Colonial timber, which for lightness and strength will take rank with any of the imported varieties we have seen.

In the outer Court devoted to ferns and potted provisions, hops, &c., are also exhibits of timber, amongst which are several beautiful burrs from the *Podocarpus totara*, and board plank of the lighter descriptions of pine. This latter feature gives the New Zealand wood a decided advantage over the Australian. With regard to this market we shall not be surprised to see the woods brought into more common use if the supply can be maintained, but that is the point. It is no use introducing a

wood, and going out of one's way to do so, unless it can be procured when wanted. It is one thing to get a sample of wood regardless of expense for an exhibition, and quite another to bring it down to a seaport in bulk, at a price which will make it popular.

We fear many of similarly highly figured woods, which are made into furniture on the spot, would never pay to export, for the simple reason that they are not sufficiently abundant. So with the Fiji woods, these are of almost every variety that have been already enumerated of the more tropical descriptions, the chief speciality being sandalwood, the logs lying in the Court literally perfuming the surrounding air. The trees are mere scrub, however, and have nothing but their scent to recommend them.—*Timber Trades Journal.*

MALTA LEMON.—Dr. E. Bonavia has frequently, in letters to the Society, alluded to this fine fruit. Some lemons grown by Mr. Stalkartt of Goosery, were recently sent to him. He writes as follows :—

"I have received the lemons you kindly sent me, and which were grown in Mr. Stalkartt's garden, Goosery. Please tell him he has the finest lemon in the world. It is neither more nor less than the Malta lemon (*Citrus limonum vulgaris* of Risso). It agrees in every possible way with that lemon—scent and shape of leaf—scent of rind, and shape of fruit; abundance and purity of the acid juice, bears a heavy crop, *heaviest* in cold weather. That is the spring crop (*sets* in Spring). Those you sent me are '*Dumrez*,' or after crop, which ripens in the hot weather and rains. With managenium this lemon tree can have ripe fruit all the year round. The 'Dumrez' is smoother, and varies often in shape from the spring crop, which is rougher. There is no one point in which Mr. Stalkartt's lemon does not agree with the Malta lemon. I should like to learn the history of it. I introduced the Malta lemon in Lucknow in 1863. Last year when I sent your Society some Malta lemon trees, you stated that there were some old trees in the Society's Garden of the same kind, and it was not known they were *Malta lemons*. Probably your old trees came originally from Lucknow, and Mr. Stalkartt may have got his from your Society. Anyhow I have been sending Malta lemon trees to Assam, and Devikulam South India, from here, and you have lots of them in Calcutta from which you could supply both East and South India. This lemon is the *best* for *decoction*, for fever and spleen. Moreover it makes the best *jelly*, for which I send you a recipe. If Mr. Stalkartt will try it, he will never eat English or Scotch marmalade again. It is, in addition, a fine antiscorbutic: I mean the lemon-jelly. This fine lemon tree is easily propagated by cuttings, in the rains in the shade of trees. This is also the

best time for *layering* it. In two months the layer's roots fill the pot. The layering is done as follows :—Take a lower branch fit for layering ; tie a bit of twine tightly below a joint, so as to cut slightly into the bark, and knot the string. Then bend the part tied, U-fashion, into a pot of good soil well drained, cover it with soil, and put a heavy brick over a surface to prevent the branch from springing out. In two months or less, in the rains, the pot will be filled with roots. This can be easily known by lifting the brick, and seeing the roots under it. Then it is fit to separate from the tree, and should be kept in the shade and watered, till planted out. Lime in any form is a good and essential manure for all Citrus trees. Any body who has a tree of this kind would do a good service by propagating it, and widely disseminating it. It propagates by *seed* and *bud* also. Seeds sown now, will be fit to plant out next rains.

"Now for the jelly recipe :—Cut up the lemon very finely, removing all the seeds. To every pound of lemon allow 3 pints of water, soak the lemon in the water for 24 hours (in the rains, perhaps less) then boil in the same water, in a *glazed vessel*, till quite tender, and let it stand another 24 hours (in the rains may be less). Then weigh 1½ lbs. of *Cossipore Crystallized* sugar, to each pound of the boiled lemon and water. Boil sugar, lemon and water till the marmalade, *on trial* will *set*. When cool, eat it with toast and butter. According to taste, more lemon juice and less rind can be used.

"I am glad to find you have this lemon tree well established in Calcutta."

Mr. Stalkartt, on being referred to as to the age of his plants, stated that he has known them to exist at Goosery for some fifty years ; so it is probable that the Society obtained their grafts from him. Firminger at page 226, Edition 1874, alludes to lemons distributed by the Society as "the common Spanish, so much used in England," though he adds, "this is not altogether similar in shape to the European fruit," *Korna Neebo* is given in Firminger as the native name, and under this name the "*Citrus medica*, common lemon," is given in the "*Hortus Bengalensis*, or a Catalogue of the Plants growing in the H. E. I. Co.'s Botanic Garden at Calcutta (1814)," and the date of its introduction is given as 1796. Mr. Stalkartt's lemons are probably grafts from these plants, which may themselves exist at the Botanical Garden.

Dr. Bonavia again writing on the subject, mentions that he calls the Lucknow lemon 'Malta lemon,' as he introduced them from that island, but it is identical with those grown in Sicily, Malta, Spain; Portugal, &c. He adds : "In the olden times the lemon was C. *medica*, then Risso and Poiteau called it *C. limonum vulgaris;* Hooker and Brandis have now called it *C. medica* var *limonum*."

In a subsequent letter Dr. Bonavia asks for samples of the

different limes and lemons obtainable in Calcutta, and these will be sent to him to assist him in the preparation of his book on this useful family.

Mr. Sturmer of Khaja, Ghazipur District, mentioned at the Meeting that he had in his garden plants of lemon exactly similar to those placed on the table by Mr. Stalkartt, and they had been in existence for some thirty years to his knowledge.—*Proceedings of Agricultural and Horticultural Society of India.*

STEEL SLEEPERS.—The progress of this latest use of steel it is well to keep under the notice of our readers, and with this view we give a couple of extracts from two engineering trade papers, *Iron* and *The Engineer*. In perusing these, it is well to bear in mind that "every new thing has a silver tail," and that, as we have before pointed out, the steel sleeper is entirely an experiment as yet. Its value as a substitute for wood has yet to be proved by the test of time. Iron is notably a much better conductor of heat than wood, and the expansion and contraction to which it is liable being therefore greater, to say nothing of its well-known susceptibility to atmospheric influences, may yet prove in the course of time, all things considered, that it is inferior to creosoted timber for sleepers.

Iron observes :—"At home the London and North-Western Railway Company have introduced Mr. Webb's sleeper on various parts of their system. It is highly spoken of by railway engineers, and is said to have given very satisfactory results. The Midland Railway Company have laid down several miles of steel sleepers, similar in section to Mr. Webb's, but with a cast-iron chair, bolted with Ibbotson's patent bolts; and they are about to lay a further portion of their road close to Derby with the same sleeper. The Metropolitan Company have also determined to lay down steel sleepers on their railway, and other companies in this country will without doubt soon follow these examples. It may, therefore, be rightly assumed that, before many years are over, this branch of steel manufacture will be largely extended at English works. An important field for the steel sleeper lies in the direction of collieries. It is well known to all mining engineers and managers of collieries that a large sum of money is annually expended in the maintenance of wooden sleepers and tramways underground, and steel sleepers would seem to possess great advantages for this purpose. A strong yet light corrugated steel sleeper, with a special steel clip for fastening, for colliery purposes, has been patented by Mr. James Colquhoun, the general manager of the Tredegar Iron and Coal Company, and was recently exhibited. In this sleeper two holes are punched in each end, and the steel clips are put in after it is laid, the rail being keyed up by a steel taper key. The corru-

gated sides of the sleeper, with the two protecting fangs at either end, enable it, when laid down, to become very firmly attached to the ballast or road, thus preventing any movement when loads are passing over sharp curves. The weight of the sleeper, with two steel keys and clips, is 16½ lbs. It is stated to have been at work for some time in collieries in South Wales, where sharp curves and steep gradients exist, and has been found to work very satisfactorily."

The *Engineer*, in much the same strain, says:—"Steelmasters are manifesting a good deal of vigour at the present time in seeking new outlets for the products of their rolling mills. Herein we mean not so much new markets as new uses to which steel may be applied. The dontains now occupied by wood are steadily but surely being encroached upon, and there are immense fields which may be gained by the steelmaster in this direction. All that is needed to bring about the much-desired change is energy coupled with some amount of patience on the part of our metal producers, and of our mechanical and civil engineers and architects. Railway construction and the provision of improved railway rolling stock might afford great scope for the steelmaker for developing his industry if engineers were a little less conservative. Happily the steel sleeper is at last beginning to make progress in this country in a manner which indicates that by-and-bye its adoption will be as general as for some time past it has been upon Continental lines. The Tredegar Company has given great attention to the sleeper business, and seems determined to push it. Other steel companies in the Principality and the North of England are also rolling colliery sleepers, and the future of the industry is bright."—*Timber Trades Journal.*

Wood Oil.—Wood oil is now being made in Sweden on a very large scale. It is abstracted from the refuse of timber cuttings and from stumps and roots in forest clearings. It cannot be burned in ordinary lamps on account of the large amount of carbon it contains; but in lamps of special construction it is said to give an excellent light, and to be the cheapest of all illuminants.

THE

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THE FOREST CONFERENCE AT DEHRA DUN.

A CONFERENCE of Forest Officers from all parts of India assembled at Dehra Dún, on the 15th October, and separated on the 24th, after a full discussion of several important questions.

The different provinces were represented as follows :—

Govt. of India,	...	Messrs. Berthold Ribbentrop, W. H. Reynolds, E. P. Dansey and E. E. Fernandez.
Madras,	...	Lieut.-Col. Campbell Walker.
Bombay,	...	Messrs. R. C. Wroughton and T. B. Fry.
Bengal,	...	Mr. E. G. Chester.
N.-W. Provinces,	...	Messrs. R. H. C. Whittall and W. R. Fisher.
Punjab,	...	Mr H. C. Hill.
Central Provinces,	...	Lieut.-Col. J. C. Doveton was deputed, but was unfortunately prevented from attending.
Burma,	...	Mr. E. P. Popert.
Assam,	...	Mr. G. Mann.
Berar,	...	Lieut.-Col. G. J. van Someren.

Besides the above, Messrs. A. F. Broun, E. S. Carr, P. J. Carter, M. H. Clifford, N. Hearle, A. Smythies and Dr. Warth took part in the discussions, and Mr. A. Smythies acted as Secretary to the Conference, and is now engaged in editing a report of the proceedings, which will shortly be published.

Pandit Sundar Lal Pathak, Chief Forest officer to H. H. the Maharaja of Patiala was deputed by his State, to attend the Conference, but did not arrive in Dehra till after its close. The more important subjects of discussion were as follows :—

FOREST TECHNICAL TERMS, of which a list has been prepared.

THE COURSE OF INSTRUCTION AT THE FOREST SCHOOL, DEHRA DUN.

APPOINTMENT OF SUB-ASSISTANT CONSERVATORS.

FOREST WORKING PLANS.

FOREST RIGHTS AND SETTLEMENTS.

GRAZING.

RELATIONS BETWEEN LAND REVENUE AND FOREST OFFICERS.

FIRE CONSERVANCY.

SUPPLY OF FOREST PRODUCE TO PUBLIC DEPARTMENTS.

After the close of the Conference on the 25th, several of the members joined in an excursion to see the improvement fellings in the Ramgarh forest, about 6 miles from Dehra.

FOREST ORGANIZATION FOR BEGINNERS.

(Concluded from page 397).

SECTION V.—PLANS OF OPERATIONS.

CHAPTER VIII.—GENERAL REMARKS.

OBJECT OF PLANS OF OPERATIONS.

The plan of operations, which is required as a guide to the management of a forest, should show the proposed working of each series, separately, for a number of years, usually 10—20.

SERIES.

As already explained, when a number of groups are worked in connection with each other so as to make up the annual yields for a whole revolution, they are said to form a *series*, and one of the principal objects of the organizer should be so to arrange the cuttings that a sustained yield may sooner or later be attained. An ideal series may be likened to a sum of money invested in an undertaking which yields an annual return without trenching on the capital invested. The whole standing-stock represents the capital, and the annual yield of the series, in which a yield equivalent to the increment only is exploited, represents the interest on the money invested.

Each series of a forest should be treated independently as a separate unit, and have a distinct plan of operations. In selecting groups for any particular series, it is essential that they should be capable of the same treatment and of, practically, the same revolution. It would not do, except as a temporary arrangement, to put groups of very different revolutions in the same series—a group subject to a revolution of 60 years, for instance, in the same series as a group subject to a revolution of 100 years, nor a coppice-group in the same series as a seed-

ling-group. At the same time, absolute uniformity in the age of exploitation of all groups is not to be expected, and the reader will have discovered long ago that the age of exploitation and the revolution of a group may be two very different things. The latter indicates merely the average age at which, on a general view of the requirements of the whole series, it appears desirable to cut groups, whereas, the actual age of exploitation is determined by special, and often unforeseen, circumstances (loss of vigour, the exigency of a good sequence, and so forth), and may differ from the revolution chosen by 10—20 years, or even by a much longer period in exceptional cases.

It is also desirable that groups of the same series should not be of very different qualities, because the most advantageous revolution for a species growing in a favourable situation may be very different from that of the same species growing in a bad one, and because the periodic areas are more difficult to regulate on variable than on uniform stations.

It is further desirable that groups composing a series should not be widely dispersed, nor straggling in numerous small detached patches. When a small patch foreign to the surrounding mass occurs in an otherwise uniform series, it should either be treated separately and excluded from the series, or gradually absorbed by changing its mode of treatment, or by substituting for it another species, if necessary. Ineradicable differences of station, species, or treatment, may necessitate the exclusion of groups: for instance, when it is considered advisable to treat a group on an exposed hill-top by the method of selection, but the lower-lying groups by a more regular method: again, a patch of swampy ground, occurring in the midst of a teak-tract may necessitate its permanent cultivation with water-loving species, to which the same treatment as that which is best for the teak may not be applicable.

It is also desirable to have a suitable gradation of age-classes, and that groups belonging to one series should be separated from those of other series by well defined artificial, or natural, boundaries, such as roads, rides and rivers.

The organizer will seldom, if ever, be so fortunate as to find all the qualities of a good series united in one forest, and when this is not the case, he will have to take the good with the bad, and make the best disposition that adverse circumstances admit. The first step to take is to decide roughly the treatment and revolution best suited to each species and station. Those to which the same treatment and revolution can be applied are then scheduled according to age-classes. The areas occupied by the latter are thus presented in a concise form: a good general view of the situation is obtained from maps coloured so as to show the age, class and species of each group; and the organizer, assisted by his notes, is then in the best position to decide how many series to have and which compartments to select for each.

The Revolution.

It may appear to the uninitiated the simplest thing in the world to determine the most advantageous revolution for a group or series. Any one unacquainted with the subject would naturally choose a revolution calculated to produce the highest priced material, and would, in all probability, thereby obtain a return of less than one per cent. on the capital invested in the forest, instead of three or four per cent. which it may be reasonably expected to yield. The matter is, therefore, not quite as simple as it may appear to be at first sight for any one who wishes to know the revolution which is likely to pay best.

As already observed, the term *revolution* is used to denote the period which has been fixed to elapse from the time of the production of a tree, or group, to the time of its being exploited. It does not necessarily correspond to the age at which a tree is harvested, because trees have sometimes to be cut, or fall from natural causes, long before the revolution decided on has been completed.

The length of the revolution generally depends on the special object of the proprietor. This may be to obtain from the land the largest possible average return (1) of material, (2) of money, or (3) the highest possible interest on outlay, or his object may be to adopt the revolution best suited to (4) natural regeneration, or (5) some special technical purpose. Revolutions fixed with a view to meet such special requirements are called, respectively, the revolution of the largest mean yearly yield (1) in wood, (2) in money, (3) the financial, (4) the physical, and (5) the technical.*

1. *The revolution of the largest return in wood.*

By dividing the cubic contents of a tree or group, by its age, we get what is called its average annual yield, or, for the sake of shortness, *average yield*. The revolution which affords the highest average yield of wood obviously corresponds to that which gives the greatest material yield.

In the Table of yields at page 98, the average yield increases steadily up to the 48th year of age, when it begins to sink and never rises again. The revolution of the largest return of mate-

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* Besides these, some writers refer to a "composite revolution," which M. Nanquette has defined as (1) that revolution which gives the largest possible quantity of material combined with the highest possible rent, or (2) which gives the largest and, at the same time, the most useful yield. By "useful material" is to be understood that which fetches the highest price per cubic foot, economically considered, it may, therefore, be far from the most useful, and, in any case, since the average material yield of a group culminates at a comparatively early stage, while the highest prices are only obtainable for very old trees, it would generally be quite impossible to combine the two qualities.

As regards the other kind of composite revolution, it should be noted that the revolution of the largest possible quantity of material may by chance coincide with the highest possible rent, but it cannot be made to do so.

rial would, therefore, be about 50 years for a group yielding the returns shown in the table.

This method of determining the revolution generally leads to very short revolutions.

2. *The revolution of the highest average money-yield.*

This is found in the same manner as the last, the average yield in money after deducting all annual expenditure, taking the place of the yield of material.

In the Table at page 487 the average yield of money increases steadily up to the 120th year of age, beyond which the table does not go. The revolution of the largest average money-yield for a group yielding the return shown in the table would, therefore, be not less than 120 years.

This way of determining the revolution invariably leads to very long revolutions, as well as to low returns on capital outlay, because the interest on disbursements which are not recouped for many years, and the discount on prospective yields are not taken into account.

The financial revolution.

An account of the methods which may be employed in determining the financial revolution is beyond the scope of these papers. Considering, however, the importance of the subject, it is desirable to give the beginner a better idea of the meaning of the term than is apparent from the bare statement that its principal object is to obtain the highest possible return on capital-outlay compatible with a good sylvicultural system. This capital consists of the cost of cultivation, of the interest chargeable on the value of the land during the revolution, and on a sum representing the interest, during the revolution, on the capitalised value of all annually-recurring expenditure, such as taxes and expenses of supervision.

Taking a plot of ground about to be stocked with seedlings, it is evident that we shall not be able to realize any return on expenditure (excepting that from thinnings and minor produce) until the end of the revolution. It is, therefore, necessary, in the first place, to calculate at compound interest the prospective amounts of all disbursements and receipts at the end of the revolution. In this manner, the values of receipts and expenses, which do not fall due on the same day, are reduced to their proper values on one particular day, namely, the last day of the revolution. By deducting the expenditure, thus obtained, from the amount of receipts, we shall get the prospective profit at the end of the revolution, with the exception of the cost of cultivation, which can be more conveniently brought to account at the beginning of the revolution. The value of this sum discounted to the beginning of the revolution will give, after deducting the cost of cultivation, the net profit on the transaction, and

the revolution which affords the highest net return, calculated in this manner, is evidently the most profitable one to adopt.

If, for instance, H_r represent the value of the crop in the r-th year, that is to say, at the end of the revolution: B the present value of the land: c the cost of cultivation: V a capital yielding the interest required to defray yearly-recurring expenditure: P the profit at the beginning of the revolution: and p the rate of interest to be employed in the calculation: we should then have

$$P = \frac{H_r - (B + V)[(1{\cdot}0\,p)^r - 1]}{(1{\cdot}0\,p)^r} - c.$$

The cost of the land, with interest, up to the end of the revolution, amounts to $B\,(1{\cdot}0\,p)^r$*; but, as we require only the interest on the capital, we must deduct B from this expression, when it becomes $B\,(1{\cdot}0\,p)^r - B$, or, in a more convenient form, $B\,[(1{\cdot}0\,p)^r - 1]$. In the same way, the interest on V is found to be $V\,[(1{\cdot}0\,p)^r - 1]$. Therefore the whole amount to be deducted at the end of the revolution from the value of the cuttings amounts to $(B + V)\,[(1{\cdot}0\,p)^r - 1]$. To get the value of this sum at the beginning of the revolution, it must be divided by $(1{\cdot}0\,p)^r$. Finally, the cost of cultivation is deducted from the result in order to obtain the net profit or loss of the speculation.

If any intermediate receipts are to be expected from thinnings or minor produce, their values at the time of falling due would have to be carried forward with compound interest to the end of the revolution, and added to the other receipts; or, to state the case in general terms, if an intermediate receipt D_a is expected in the year a, it would appear in the form $\frac{D_a\,(1{\cdot}0\,p)^{r-a}}{1{\cdot}0\,p^{r-a}}$. The general formula is, therefore,

$$P = \frac{H_r + D_a\,(1{\cdot}0\,p)^{r-a} + D_b\,(1{\cdot}0\,p)^{r-b} + \&c. - (B + V)[(1{\cdot}0\,p)^r - 1]}{(1{\cdot}0\,p)^r} - c$$

When D_a, D_b, &c., represent intermediate receipts in the years a, b, &c.

In order to determine the financial revolution of a group, it is of course necessary to know the probable value of the material to be produced from period to period. Supposing we have experiential tables showing the probable returns per acre for a given species growing under the conditions assumed in the

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* The formula for calculating compound interest is $A = P\left(1 + \frac{p}{100}\right)^r$ or, in the above form, $A = P\,(1{\cdot}0\,p)^r$, when A represents the amount, P the sum invested, p the rate of interest, and r the number of years the investment runs. From this formula, the present value, P, of a sum, A, which falls due r years hence may be deduced: $P = \frac{A}{(1{\cdot}0\,p)^r}$.

tables, and that those returns, neglecting intermediate receipts, are those shown below. Taking $p = 3$, $V = 10$, $c = 10$, $B = 10$, the profits per acre for revolutions proceeding by differences of ten years are shown in the last column of the table.

Revolution, r years.	Value of group, Rs.	$(1{\cdot}03)^r - 1$.	$B + V$	$(1{\cdot}03)^r$	$c \times d$	$b - f$	$y \div e$	Net profit at beginning of the revolution. $h - 10$.
a	b	c	d	e	f	g	h	Rs.
50	128	3·38	20	4·38	67·6	60·4	14	4
60	203	4·89	20	5·89	97·8	105·2	18	8
70	312	6·92	20	7·92	138·4	173·6	22	12
80	462	9·64	20	10·64	192·8	269·2	25	15
90	649	13·30	20	14·30	266·0	383·0	27	17
100	874	18·22	20	19·22	364·4	509·6	27	17
110	1,146	24·83	20	25·83	496·6	649·4	25	15
120	1,429	33·71	20	34·71	674·2	755·8	22	12

According to this estimate, a revolution of 90—100 years affords a maximum profit of Rs. 17 per acre, and 90—100 years would, therefore, be the most advantageous revolution for the group.

4. *The Physical Revolution.*

This has been already defined as that best suited to natural regeneration. General and special rules for its determination are laid down in books on sylviculture. It may vary considerably according to circumstances, for the same species of tree, and depends mainly on the kind of tree, station, and régime (coppice or seedling-forest).

The Technical Revolution.

This has been defined as the revolution best adapted to yield wood suitable for certain technical purposes, such as timber for ship-building, props for mining, and cannot, therefore, be given in general terms.

Choice of a Revolution.

With the exception of comparatively small portions kept for ornament, private owners will generally wish to get as large a permanent revenue from their estates as possible, and for this purpose there can be no doubt as to the most favourable revolution—the financial. But when it is a question of forests belonging to the State, it is frequently urged that the financial revolu-

tion is unsuitable, and that, cost what it may, it is the duty of a Government to provide for all possible requirements of the community, and more particularly to prevent a diminution of the present supply of large timber. No doubt a good deal may be said in favour of this view. In the first place, it is undeniable that forests which can be cut down in a day may take years, or even centuries, to replace: that financial revolutions are comparatively short; and that it would never do to rely on private enterprise for the supply of the largest timber, more particularly as it seldom pays to grow it. Indeed, experience teaches that private individuals cannot be relied upon to provide a steady supply of even small timber, or firewood, which *does* pay; the temptation to exceed the capability of the forest, or to convert all the standing stock into gold, whenever money is required by the proprietor, is irresistible, and not to be restrained by other people's ideas of moral obligations to themselves and posterity. Opponents of a mercantile revolution consider, therefore, that a complete failure of the supply of large timber, which would perhaps take a century or more to replace, might easily be brought about by the general introduction of financial revolutions into a country: that such failure would certainly cause serious national inconvenience: and that it is, therefore, the proper function of Government to guard against any such contingency by adopting very long revolutions in State forests. Now, without denying that circumstances (those of protective forests, for example) are conceivable which would render it advisable for the State to keep a forest standing after it had reached financial maturity, advocates of the financial revolution may reply somewhat as follows:—As a general rule, it is the duty of a Government to make the most of the property entrusted to its charge, rather than to anticipate and provide for highly-improbable contingencies which, if they ever did threaten to arise, would certainly not in these days take everybody so entirely by surprise as some people would have us believe. The Government timber-forests of civilized countries are of vast extent: they are all systematically managed, or in a fair way to be so,* and could not, therefore, be swept away as if by magic, nor the standing-stock suddenly reduced to a great extent, because that would involve the sale of largely increased quantities of wood, which could not be quickly disposed of without great loss. The stock could, therefore, only be gradually reduced, and scarcity of any particular description of wood would be felt long before the standing stock of it was exhausted. But growing scarcity of any particular commodity would be accompanied by increased demand, and cause a corresponding rise in its price until the demand was satisfied, whilst a steady and lasting rise

* Those of the Continent of America, perhaps, alone excepted. In Canada, at all events, no real attempt seems to have been made in this direction.

in the price of any description of produce would cause an increase in its production under the financial system. In a well-regulated forest, therefore, this system would, it is maintained, serve as a gauge of the requirements of the public, and regulate the supply in sympathy with their most pressing wants.

Another consideration that favours the adoption of financial revolutions is that iron is now generally used for large structures in preference to timber, so that as long as these cheap, and apparently inexhaustible, substitutes are procurable, there can be little fear of the world's being inconvenienced by a falling-off in the supply of very large timber.

Of course it is not to be expected that the financial revolution can be accurately determined for seedling-forests. But a degree of accuracy is obtainable which amply suffices for all practical purposes: a few years more or less is not of the slightest importance. What is necessary, is a recognition of the soundness of the principle, and of the expediency of applying it more or less roughly whenever practicable. If this is done, we shall soon cease to hear of revolutions 300 years in length, or of duration still more absurd.

Proportion of Age-classes.

This may be shown for series subject to the method of regular cuttings, in a table similar to that at page 290, groups which are to be separated from the rest of the series being put in a separate column.

The age-classes are generally made to correspond to the periods. If periods are twenty years long, the age-classes should proceed by differences of twenty years.

Speaking generally, groups in process of natural regeneration by seed may be reckoned as belonging to the oldest class up to the time of the first secondary cutting. The quantity of old trees still standing is, however, the best guide. If we have, for instance, 100 acres of forest in process of regeneration, whose normal supply is altogether 400,000, but whose actual supply is found to be only 100,000 cubic feet, the average contents for a completely-stocked acre would be $\frac{400000}{100} = 4{,}000$ feet. There would, consequently, be the equivalent of $\frac{100000}{4000} = 25$ acres of the oldest class, and $100 - 25 = 75$ acres of young growth.

Wastes which it is intended to re-stock, should not be entered in an age-class until they have been re-stocked; but the last yearly coupe, or coupes, which is regularly re-stocked, should be entered in the first class.

The number of years necessary to realize the ideal state.

In series managed by the method of regular cuttings, an effort should be made to effect a practically normal state of the

age-classes of a series by the end of the first revolution, or within the term of years required to work through the whole forest. It may not, however, be advisable to accomplish this so quickly in forests in which the age-classes are very abnormal, on account of the sacrifice of immature, or the delay in cutting over-mature, groups, which a too sudden regularization might entail. It would generally be advisable, for instance, to exceed at first the normal coupe considerably, in a series of three age-classes, of which the first two were largely overstocked, and to reduce the annual coupe below the normal if they were considerably understocked.

Periods.

In series subject to the method of regular cuttings, very short periods are apt to hamper the executive, especially in forests naturally regenerated by seed, where greater freedom in locating the cuttings is necessary than in forests which are independent of "seed-years," and which can be regenerated with much greater certainty, regularity, and rapidity.

Another objection to very short periods is that they make the gradations of the age-classes too small.

On the other hand, very long periods are apt to allow too much license to the executive in carrying out the provisions of the plan.

Five to twenty years may be taken as limits. Thirty years were formerly the usual term for forests with long revolutions; twenty is now more general for seedling-forests, naturally regenerated, and ten for those regenerated by the method of clean cuttings, or, and this comes to the same thing, the twenty-year-periods are divided into sub-periods of ten years each.

Allotment of Groups to Affectations.

As a rule, the oldest groups should be cut first. Circumstances will, however, often prevent this arrangement. If we had, for instance, to choose between two groups, one old but vigorous, the other comparatively young, but sickly from mismanagement, attacks of insects, damage by fire, &c., or on account of the species being unsuited to the station, we would probably elect to cut the younger group first.

Again, in order to obtain a proper sequence of cuttings it may be necessary to cut younger groups before older ones; or in order to avoid having very large areas stocked with groups of about the same age where there is fear of damage by wind, or for other reasons.

Protective Cuttings.

These are very important in forests subject to the method of regular cuttings, and occupying sites exposed to violent storms.

As already explained, they consist in clearings 30 feet or more broad, made on the weather side of a group when it is young, so as to avoid the danger of suddenly exposing it when old to wind and sun, when the group in front of it is cut. The area thus cleared may be re-stocked with young growth, which then forms a protective fringe, or it may be left bare.

The usefulness of these protective cuttings in saving groups from premature cutting, or in rendering cuttings in due course possible may be very great in forests treated by a method of regular cuttings, and the principal reason why it is advisable to obtain, at the beginning, a rough idea of the course of the coupes during the whole of the revolution. The age up to which protective cuttings may be safely made in a group depends on the kind of tree, the conditions under which it is growing, and the station. Some species withstand wind much better than others; conifers, especially those with only tracing roots, must be most carefully dealt with.

Extraordinary Thinnings.

These may be indicated when it is necessary to cut a group before its exploitable age, in order to hasten its growth, or its seed-producing power in case the group is to be naturally regenerated. When the thinning is very severe, it will be often advisable to introduce young-growth of shade-enduring species in order to protect the soil. If the group is to be cut within the next 20—30 years, this young-growth may sometimes be utilised in re-stocking the ground when the overwood is cut away.

Reserve-Groups.

Reserve-Groups are groups specially set aside for the purpose of making good any deficiency of material which may arise from unforeseen circumstances, such as an excessive estimate of the quantity to be exploited, losses owing to fire, insects, windfall, and so forth. They have not been found to answer. If taken from amongst exploitable groups with the intention of substituting from time to time younger groups, the arrangement interferes with a proper plan of cuttings; and if they are chosen from younger groups, there is always the chance of their not being exploitable when required.

Several other expedients for establishing a reserve-fund have, therefore, been resorted to, such as lengthening the revolution beyond the proper term, reducing the estimated yield so and so much per cent., neglecting the increment of groups to be cut during the first period, reserving specially fine and vigorous trees as standards, &c.

Of these, the plan of lengthening the revolution, deducting a certain percentage from the estimated yield or reserving standards, appear to be the least objectionable; but these and all others

involve a sacrifice of revenue in forests subject to a rational system of management, and it is therefore difficult to understand why a certain loss should be incurred in order to avoid a possible one. The case is not at all analogous to that of an industrial undertaking in which a reserve-fund is formed. In the latter case no loss is incurred by the formation of a reserve-capital, which is invested either in the business itself, or in other funds producing interest at the full market-rate in proportion to the security they afford; whereas in forests, the reserve is invested at a lower rate of interest, in funds, *i.e.*, forest, which do not offer greater security than if they were made to return the proper rate on capital-outlay. How this question is decided may not be a matter of very much importance; but as the principle of establishing reserve-funds in forests appears to be wrong, the simplest and best plan is evidently to dispense with them altogether.

Chapter IX.—Preparation of Plans of Operations.

As this plan is intended to furnish the *raison d'être* of the proposed general plan of management, together with detailed instructions for the next ten or twenty years, it should commence with a general description of the forest and of the circumstances which have led to the proposed system of management. This account can be compiled from the facts collected during the examination of the forest. It should be condensed; only essential points being noted in order that the leading features may not be obscured by a mass of detail.

These introductory remarks may comprise all, or part, according to circumstances, of the following particulars and any other matters of interest.

1. The actual state of the forest and its surroundings.

This should comprise a short history and description of the forest:—General topography, station and tenure; prevailing species; past management, expenditure, and receipts. Circumstances affecting its general management, such as the requirements of the surrounding population, markets, rights, and privileges, the existence in the vicinity of industries requiring a steady supply of forest produce. Particulars regarding communications and forest offences and means of preventing the latter.

2. Circumstances affecting the yield.

Reasons for the series and revolutions chosen; and for changes if any, of régime or species. Reasons for the methods adopted for determining the annual yield and contents of groups.

The probable state of the age-classes at the end of the revolution may be noted. Circumstances not now affecting the value of the produce but likely to do so, such as the construction of new or improved lines of communication, the starting of new industries (mines, factories, &c.). Directions in regard to the general management of the forest; such as directions as to the mode of carrying out the main-cuttings, thinnings, draining, and cultural operations. Reasons for alterations, if any, in the executive or protective establishments. Reasons for the system of differentiation adopted, and for any proposed new lines of communications.

3. Yield.

General statement of past and estimated future annual yield from main-cuttings, thinnings, and minor produce (all separately).

The plan of operations should include the following :—

(1). General plan.
(2). Statement of boundaries (in the form shown at p. 291).
(3). Of compartments and groups (in form at page 289).
(4). Of age-classes (form at p. 290).
(5). Detail-plan of main-cuttings.
(6). Detail-plan of thinnings.
(7). Statement of total estimated yield.
(8). Regeneration and cultivation-plan.
(9). Maps.

General Plan.

This is intended to give a general view of the present state of the forest, and its working for the next ten years, or for a longer period.

It may be drawn up in the following form for series treated by the method of regular cuttings. For forests exploited by the selection-method, and for the overwood of stored coppice obvious alterations are necessary: the number of trees of a class takes the place of area under the headings *age-class* and *periodic yield*, and the yield of the test-tree of a class that of the class-yield per yield acre, and, when the number of trees regulates the yield, columns will be necessary showing the numbers of each class to be cut, for the column showing the age of groups, the range of ages (*e.g.*, 5—40 years) or the range of diameters (*e.g.*, 0—10 inches), may be substituted. When the yield is given in cubic feet a column showing the rate of growth per cent. should be given for each age-class, or for each diameter-class if the latter be substituted for age-classes.

If there are other series in the range, separate statements should be made for each. A general statement may then be drawn up of the operations to be carried out during the first period, or decade, for the whole forest.

General Plan of Working.

he First Series of Kodali Range.

Revolution 60 years.

Locality.	Compartment.	Sub-compartment.	Area.	Quality of		Density.	Species, Régime, Mode of Treatment.	Age of Group.	Contents per Acre.	Age-classes. 1-20. Area.	1-20. Contents.	21-40. Area.	21-40. Contents.	41-60 and over. Area.	41-60 and over. Contents.	Unstocked area.	First Period.—1887-1906. First Decade. Area of Coups.	First Decade. Yield of Material. Per Acre	First Decade. Yield of Material. Total Yield.	Second Decade. Area of Coups.	Second Decade. Yield of Material. Per Acre.	Second Decade. Yield of Material. Total Yield.	Second period.—1907-1926.	Third period.—1927-1946.	Remarks.
				Station.	Crop.																				
			acres.						c. ft.	acres.	c.ft.	acres.	c. ft.	acres.	c. ft.	acres.	acres.	c. ft.	c. ft.	acres	c. ft.	feet.	acres.	acres.	
Belmal,	1	*a*	10	II	II	1·0	Terminalia seedling-forest clean cuttings.	15	..	10	..	..	..	..	..	..	..	..	..	1	2,300	2,300	..	9	1*b*. Protective cutting.
,,	..	*b*	5	,,	,,	,,		80	7,000	..	..	..	..	5	35,000	..	5	7,250	36,250	..	..	..	..	..	9*b*. To be planted up at once with terminalia seedlings, at distances of 4 feet, in lines 4 feet apart.
,,	..	*c*	20	,,	,,	,,		5	..	20	..	..	..	..	..	..	..	..	..	T	..	..	..	20	
,,	4	*a*	32	,,	,,	,,	,,	30	..	..	..	32	73,600	..	..	..	T	..	..	..	..	..	32	..	
,,	..	*b*	3	,,	,,	,,	,,	30	7,500	..	..	..	..	3	22,500	..	3	7,700	23,100	..	..	..	..	..	
,,	..	*c*	10	,,	,,	,,	,,	15	..	10	..	..	..	..	..	..	T	..	..	..	..	..	..	10	
,,	7	*a*	18	,,	,,	,,	,,	5	..	18	..	..	..	..	..	..	..	..	..	T	..	..	..	18	Underlined are those which are to be coupe and re-stocked during the first period.
,,	..	*b*	17	,,	,,	,,	,,	60	5,400	..	..	..	..	17	91,800	..	..	..	..	13	6,650	86,450	4	..	
,,	..	*c*	12	,,	,,	,,	,,	5	..	12	..	..	..	..	..	..	T	..	..	..	..	..	..	12	
,,	8	..	50	,,	,,	,,	,,	70	6,300	..	..	..	..	50	315,000	..	28	6,650	186,200	22	7,250	159,500	..	..	
,,	9	*a*	30	,,	,,	,,	,,	40	3,300	..	..	30	99,000	..	..	..	T	..	..	..	..	..	30	..	Those marked T are to be thinned.
,,	..	*b*	5	,,	,,	,,	,,	..	..	..	..	..	..	..	..	5	..	..	..	T	..	..	..	5	
,,	..	*c*	8	,,	,,	,,	,,	50	4,400	..	..	..	..	8	35,200	..	..	..	..	..	..	..	8	..	
Total,	..	..	220	,,	,,	,,	,,	..	..	70	..	62	..	83	..	5	36	..	245,550	36	..	248,250	74	74	The increment of groups was estimated by means of local experiential tables accompanying this statement.
							Estimated Average Annual Yield,											..	24,555		..	24,825			

DETAIL-PLAN OF MAIN-CUTTINGS.

This may generally be drawn up in the following form. But it will not always be possible to give the area; for coppice wood in stored coppice and forest exploited by the primitive method, for example (see above). In cases of natural regeneration, when the old crop is only gradually removed, it will suffice to put down in red ink an area proportional in size to the quantity of wood remaining to be cut, making a note to that effect in the remarks column (see also remarks, p. 223).

PROPOSED MAIN-CUTTINGS 1887-96.

Locality.	Compartment and Sub-compartment.	Area of coupe.	Species.	Age-class.	Quality class.	Cubic contents. Feet.	Remarks.
Belmal,	2*b*	5	Terminalia.	III.	II.	36,250	2*b*.—At beginning of decade.
„	5*b*	3		„	„	23,100	5*b*.—Ditto.
„	8	28		„	„	186,200	
Total, ...	...	36	...	...	...	246,550	
Average yearly yield, ...						24,655	

The above form should be on the left side of the sheet, and the following on the right. The proposed cuttings can then be conveniently compared with the actuals.

The quantities should be shown separately for different qualities of wood (logs, poles, firewood, &c.), or at all events, timber and firewood should be kept separate.*

* The classification adopted will, of course, depend on local circumstances. In many places, firewood would not be classified at all because unsaleable, and what may be valuable only as firewood in one country, may be used for constructive purposes in another.

Main-Cuttings actually carried out.

Compartment.	Decade 1887—1896.																				Remarks.
	1887.		1888.		1889.		1890.		1891.		1892.		1893.		1894.		1895.		1896.		
	Area.	Quantity.	Area.	Quantity.	Area.	Quantity.	Area.	Quantity.	Area.	Quantity.	Area.	Quantity.	Area.	Quantity.	Area.	Quantity.	Area.	Quantity.	Area.	Quantity.	
5*b*	3	26,540																			Only 27 acres of compartment 8 were coupe owing to windfalls in 7*b*, from which the full yield was made up.
2*b*	...	...	3·5	24,610																	
				&c.		&c.															
Total,	3	26,540	3·5	24,610																	

DETAIL-PLAN OF THINNINGS.

These should be scheduled in the same manner as the main-cuttings, the actuals and the estimate being recorded on opposite sheets.

As regards the quantity and quality of the intermediate cuttings, the usual plan is to make the estimate by means of experiential tables of average returns of groups of about the same age and of the same species. Much depends on previous treatment and on how a group originated; density and station are the most important factors to consider, and the results of previous experience may be modified as each case appears to require.

When neither local nor general tables exist, some data will probably have been collected during the examination of the forest which will serve as a guide.

Often thinnings have no value, or they are removed by permit-holders and cannot be calculated on. In such cases it is needless to observe that there is no object in estimating the quantity.

STATEMENT OF TOTAL YIELD.

This may be drawn up in the following form :—

Abstract of estimated total yield for Decade 1887-96.

Aggregate area of coupes.	Main cuttings, cubic feet			Thinnings, cubic feet.			Grand Total.
	Timber.	Firewood.	Total.	Timber.	Firewood.	Total.	
Total, ...							
Mean yearly yield, ...							

REGENERATION AND CULTIVATION-PLAN.

This will comprise instructions for filling up blanks, cultivation of wastes, and regeneration of groups. The proposed plan should be written on the left side of the sheet and the details of its execution on the other.

The following form may be used :—

Left Side of Sheet.

CULTIVATION-PLAN.

FIRST DECADE 1887-1896.

Work Proposed.

Compartment.	Filling up of blanks.	Cultivation of wastes.	Regeneration of group.	Remarks.
1*a*,	...	...	3	To be taken in hand at once.
2*a*,	...	8	...	
	&c.	&c.		

Right Side of Sheet.

WORK ACTUALLY CARRIED OUT.

Compartment. No.	1887.	1888.	1889.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	Total.	Remarks.
	Area, Acres.											
1*a*,	3	...	...	...	...	...	...	...	...	...	3	Terminalia plantation 1 year seedlings at 4 feet distances.
2*a*,	8	...	...	...	...	...	...	...	...	...	8	Waste to be stocked with alternate rows of teak and bamboo.
			&c.		&c.							
Total,												

Maps.

The following maps will be required by the Executive:—
(1). Group-Map.
(2). Working-Map.
(3). Inspection-Map.

Group-Map.

This map should be on a smaller scale than the original map; about 4 inches to the mile, $\frac{1}{15840}$, will generally suffice. The groups should be indicated by colours, each kind having a different colour, and each age-class having a certain depth of colour, the youngest age-class being lightest, and the oldest darkest. A good general idea of the proportion and position of the age-classes and species of forests subject to the method of regular cuttings is thus obtained at a glance.

Working-Map.

This should be a copy of the original map, on the same scale, and not coloured. It will be required for detail work, such as boundary-mark inspections and measurements, and should be on a scale large enough to show every bend and boundary-mark, and to admit of accurate measurements being made from it.

Inspection-Map.

This map is required for general purposes, such as inspections, and should, therefore, be made of convenient size, on a scale which may be made the same for all forests belonging to one proprietor, or may depend on the size of the range. The 4-inch scale $\frac{1}{15840}$, is a convenient size. The boundary-marks are not shown in this map, as it is not generally large enough for that purpose; but all rides, roads, compartments, sub-compartments, streams, and salient features of the country should, if possible, be filled in.

5. Booking Results and other details.

A record should be kept by the Executive of—
(1). Changes, if any, affecting survey-details.
(2). Details of cuttings, actual and proposed, for main-cuttings and thinnings, in the forms given above.
(3). Details of cultivation actual and proposed in the forms given above.
(4). Comparative abstract, showing the estimated and actual quantity of cuttings, together with the sums realised by their sale.

(5). General abstract of receipts and expenditure.
(6). Estimated and actual quantity of, and receipts and expenditure on account of, minor produce.
(7). Abstract of average gross and net value of a cubic foot of wood, arranged according to species and régime.

Changes affecting Survey-Arrangements.

The chief points to note are changes of absolute area on account of sales, purchases, exchanges, &c. Increase, or decrease, in the area of stocked as compared with unstocked land, on account of new rides, roads, the stocking of wastes, newly-acquired land, &c. Alterations in the position of boundary-marks. Alterations which do not affect the relative proportion of stocked to unstocked area, such as the laying-out of narrow roads, building of bridges, cutting of ditches.

Changes outside the forest-area affecting the sale of its produce, such as new lines of communication, railways, factories.

All changes should also be noted on the map, if possible.

The yearly coupes should be marked on the map in pencil.

These changes should be put down in a note-book kept specially for the purpose, and of the following form :—

Changes which have occurred.	Remarks.
1887.	
Coupes.—1*a*, 3 acres cut clean, ...	Marked on map, Nov., 1883.
1888.	
Coupes.—1*a*, 2 acres cut clean, ...	Marked on map, Nov., 1884.
2*a*, 3 „ „ ...	
Boundary-mark, No. 115 missing, ...	Replaced by stone mark April, 1885.
&c.	

Abstract of the Estimated and actual Quantity and Value of the Cuttings.

This should be drawn up for main-cuttings and thinnings (1) separately, and (2) together, as shown in the accompanying tables, subject to such modifications as may in each case appear necessary.

1. *Main-Cuttings.*

Year	Actual area of coupe.	Estimate.			Actuals.			Value realised.		The actuals as compared with the estimate are					
										Timber.		Firewood.		Total.	
		Timber.	Firewood.	Total.	Timber.	Firewood.	Total.	Gross.	Net.	Too much	Too little.	Too much	Too little.	Too much.	Too little.
		Cubic feet.			Cubic feet.			Rupees.		Cubic feet.					
1887	4·00	15,000	9,000	24,000	16,180	8,120	24,300	18,541	12,745	1,180	...	...	880	160	...
1888				&c.			&c.								

2. *Thinnings.*—The same form as above.

3. *Total Yield.*

The same form as the above, containing the sum of main-cutting and thinnings.

General Abstract of Receipts and Expenditure.

This is intended to show at a glance the gross and net yield of the forest, and may be drawn up in the form opposite, subject to such modifications as circumstances may require.

Estimated and actual Quantity of, and Receipts and Expenditure on account of, Minor Produce.*

This statement may be drawn up in the following form. When the receipts are small, or the produce is sold in a lump for the whole forest, the information contained in the remarks column of the General Abstract will suffice, and this detailed statement may be dispensed with.

Year.	Compartment.	Produce estimated.			Actuals.		The estimate is, as compared with the actuals.			
							Quantity.		Value.	
		Description.	Quantity.	Value.	Quantity.	Value.	Too much.	Too little.	Too much.	Too little.
1887	Whole forest,	Right of grazing in compartments not in fence,	...	700	...	375	...	...	...	275
				&c.	&c.					

Minor produce is all produce not ligneous (fruit, game, &c.).

General Abstract of the Receipts and Expenditure.

Year.	Forest Area.			Wood sold.			Receipts.			Expenditure.							Net return.		Remarks.
	Stocked.	Unstocked.	Total.	Timber.	Firewood.	Total.	On account of wood.	On account of minor produce.	Total.	For harvesting wood.	Harvesting minor produce.	Forest improvement, cultivation, &c.	Pay of protective and other establishments.	Rates.	Miscellaneous charges.	Total.	Total.	Per acre.	
	Acres.			Cubic feet.			Rupees.			Rupees.							Rupees.		
1887	220	10·5	230·5	16,180	8,120	24,300	18,541	1,000	19,541	5,796	0	150	500	100	45	6,591	12,950	56	1887.—The minor produce sold consisted of the following items, and was collected and removed by purchasers themselves. Rs. Right to wild fruits, ... 25 Do. grass, ... 975 Total, 1,000
1888	...	...	&c.	...	...	&c.													
1889	...	...	&c.	...	...	&c.													

ABSTRACT OF GROSS AND NET VALUE OF A CUBIC FOOT OF WOOD.

This statement may be drawn up in the following form, subject to such modifications as circumstances may demand :—

Year.	Species and régime.	Number of cubic feet cut.	Gross value.	Net value.		Remarks.
				Total.	One cubic foot.	
1887	Terminalia, clean cuttings, ...	4,000	1,000	650	·14	The average age of the Terminalia was about 60 years; of the Xylia about 80.
1887	Xylia naturally regenerated seedling-forest, ...	&c.	...	&c.		

CHAPTER X.—RENEWAL AND REVISION OF THE PLAN.

At the end of each period, or sub-period, the general plan of operation will have to be revised, and fresh plans framed for working the forest during the following period or decade.

Sometimes serious calamities such as extensive damage by insects and wind, renders an earlier revision necessary. In forests worked intensively, or which are very irregular, it is generally advisable to have intermediate revisions at intervals of five years.

RENEWAL OF THE PLAN.

The points to consider are (1), how the proposed plan has answered during the past period or decade. (2), the preparation of a new plan of operations for the next period or decade.

As regards the first point, it will be easily determined, if the records have been properly kept, by comparing the estimate with the actuals. Each item (main-cuttings, thinnings, minor produce, &c.) should be taken, *seriatim*, and compared with the estimate. Serious mistakes in the original plan, or in the manner of carrying it out, will soon be brought to light, and steps can be taken to avoid their recurring, if possible, during the next period. An examination of the work done in the forest will show whether the cuttings were suitably located and their sequences satisfactory; and also if other works, such as those

of regeneration, road-making and cultivation, have been satisfactorily carried out and with what result.

Before commencing to prepare a fresh plan for the next decade, or period, the map and statements should be corrected so as to show the existing situation. Sub-compartments, for which there is no longer any occasion, will be done away with on the map and in the statements; and if new land has been taken up it will be apportioned to existing compartments, or made to constitute new compartments. It is well to prepare an entirely new map of groups.

It will then be necessary to make an entirely fresh examination and assessment of the forest, or, at all events, of groups which it is intended to fell during the next period. A detail-plan of operations, based on this estimate, is then drawn up for the coming term in precisely the same manner as the previous one, but it will not be necessary to repeat the general description which preceded the plan for the first period. A few introductory remarks will suffice to call attention to changes which may have occurred, and to the results of the working of the forest during the past period.

Revisions.

The object of these is to show how the plan of operations has worked, and to make such alterations within the prescribed limits of the original plan as appear necessary, but neither fresh assessments of groups, nor a working-plan for the next decade or period, is made. The scope of new revisions is, therefore, much more limited than that of renewals, and they partake more of the nature of an inspection than of a revision. They are, therefore, most useful in forests, such as those belonging to the State, in which the work of the executive is controlled by superiors. They are also useful in cases in which unforeseen circumstances, such as windfalls on a large scale, or the sudden demand for a particular kind of produce, necessitate a change of working. It will then be a question whether an entirely new plan should be framed or not, or if the old one can be altered sufficiently to satisfy the new conditions.

SECTION VI. CONVERSIONS.

Chapter XI.

Simple-coppice, stored coppice, and forests which have been treated by the primitive method, have sometimes to be converted into regular seedling-forest. Considerations of sylviculture may sometimes render such a conversion desirable, as is the case when the impoverishment of the soil necessitates a change of species and system (*e.g.*, from deciduous to coniferous forest).

Other considerations, again, may necessitate a change, such as questions of finance, or the wish to attain a more simple and regular system. Generally speaking, the composite method is not suited to very large forests, because the personal attention of a skilful manager is required for nearly all operations in the forest, and he will seldom have time to attend to them thoroughly in extensive series. The principal objection to the primitive method is the difficulty of determining the sustained yield and of ensuring the regeneration of the forest.

Grebe divides the material to be exploited in the conversion of primitive forest or stored coppice, to regular seedling-forest, into :—

(1). Main-cuttings of the groups to be converted.
(2). Improvement-thinnings of original standing-stock, or cuttings which prepare the way for the main-cuttings.
(3). Thinnings of converted groups.

The forest should be divided into affectations of equal, or nearly equal, area, according to the same author, who gives, as an example, the case of a forest of stored coppice to be converted in four periods to regular seedling-forest, alloting groups to affectations in the order shown below.

1st Period.

1. Groups which are thoroughly exhausted to be cleared off, and the ground re-stocked artificially.

2. Groups with tolerably dense young-growth (underwood), consisting mainly of vigorous seedling or coppice-shoots of hard-woods. Most of the latter to be allowed to stand and grow into high forest.

2nd Period.

3. Groups with sufficient overwood to allow a preparatory cutting for natural regeneration to be made, but mostly deficient as regards under-wood.

3rd Period.

4. Groups whose overwood is too sparse for a preparatory cutting, and which will, therefore, have to be prepared for it by improvement-cuttings and the retention of a large supply of stores.

4th Period.

5. Groups which are deficient in both over- and under-wood, but which can be sufficiently prepared for regeneration by filling up blanks during the first period, and by retaining a large number of stores from the under-wood.

6. The waste and coupes, stocked during the first period, if necessary.

The course of the cuttings would then be as follows:—

Period.	Groups under Headings (1) and (2).	Groups under (3).	Groups under (4).	Groups under (5) and (6).
I.	Regeneration cuttings.	Preparatory cuttings.	Improvement cuttings.	Improvement cuttings.
II.	Improvement cuttings and thinnings.	Regeneration cuttings.	Preparatory cuttings.	Improvement cuttings and thinnings
III.	Thinnings.	Improvement cuttings and thinnings	Regeneration cuttings.	Preparatory cuttings.
IV.	Thinnings.	Thinnings.	Improvement and thinnings.	Regeneration cuttings.

The above example will serve to indicate the general course which events may be expected to take, each case being treated according to its special conditions.

The yield for the first ten years is based on an examination of the growth and contents of each group, or portion of a group, to be cut during the decade. It will not, however, be necessary to attempt to estimate the contents and increment of any groups beyond those which are to be worked during the first ten years.

The improvement-cuttings will, of course, include the removal of very old standards which are not suitable for natural regeneration, and it will, therefore, often be difficult to avoid felling an excess of large timber during the first period.

The groups of later periods should be fixed provisionally, as the soundness of the plan for the first period will thereby be more generally demonstrated. But as time goes on, it may be found necessary to transpose groups from one period to another, it being impossible to predict positively which groups will be most suitable for regeneration twenty or thirty years in advance.

The general principles to be followed in converting other kinds of irregular forest to regular seedling-forest are the same as for stored coppice. The worst groups, and those most suitable for regeneration, are cut first, and the rest, "improved." A more simple plan is to regenerate the entire forest artificially, but that is not always a feasible one; it is always a much more expensive method.

A TOUR IN JAPAN.

HAVING recently spent a month in Japan, "en route" for America, some account of that remarkable country may interest the readers of the "Indian Forester." The empire of Japan consists of a collection of nearly 4,000 islands, the principal of which are Niphon, situated in the centre, Jesso in the north, and Kinsin in the south. The area of the empire is understood to be 149,000 square miles, or about 28,000 square miles more than that of Great Britain and Ireland, whereas the population is supposed to be about the same, *viz.*, 33 millions. The physical features of Japan are most variable, and mountains, valleys, plains and rivers, combined with an irregular coast, are everywhere picturesquely blended.

In the north the winters are cold and severe, and snow covers the mountains for several months, but in the southern part of the empire, snow seldom lies more than a few days.

The average rainfall is said to be about 50 inches, this amount being distributed over several months of the year; the maximum number of wet days during May, June and September being 10 or 12, whereas during the other months, they do not as a rule exceed 4 or 5.

Earthquakes are frequent, and severe storms or typhoons, which sweep everything before them, are not uncommon.

The history of Japan as regards its relations with the outer world is most curious and interesting. Various unsuccessful attempts having been made for more than 300 years, by the Portuguese, Dutch, Russians, Spaniards and British to enter into commercial intercourse with it, but without any satisfactory result.

In 1854 however, the Government of the United States eventually succeeded in negotiating a successful treaty, and the ports of Hakodadi and Simoda were opened as coaling stations and to commerce generally.

Great Britain, France and Russia soon followed, other ports being also opened, and since these events the country has made the most rapid strides towards civilization which has ever been made by any ancient or modern nation.

The ancient Government of Japan was constituted on a most peculiar footing, and consisted of the Makado or Emperor, whose power was merely nominal, the real ruler being the Tykoon or Shogun, who had at his back as supporters a powerful set of nobles or chiefs called Daimios. In 1868, however, a great revolution took place, which resulted in the suppression of the Tykoon, as well as a considerable limitation in the power and importance of the Daimios, and the assumption of full authority by the Makado. Since this important event, the whole internal arrangement of the country has undergone a complete revolution, and security to life and property ensured by the suppres-

sion of the numerous two-sworded men and other armed retainers of the Daimios. The Government of the country has now been remodelled on a European system, and the administration divided into different departments, the chiefs of which form a kind of Council presided over by the Makado.

The construction of railways, telegraph lines, roads and bridges is now making rapid progress under the direction of the various Government departments; a good system of Police has been established, and a fairly efficient army is being equipped on the German system.

As regards maritime matters Japan now possesses a fairly efficient navy, and most of the merchant steamers of Japan are well managed and efficient. Extensive dockyards have been started at Yokoska, near Yokohama, and a law has just been passed prohibiting the building of the old class of unseaworthy junks, their place being taken by schooners, brigs or similar craft.

The mineral wealth of the empire is important, and includes copper, coal, silver, lead, tin, sulphur, nitre, salt, lime, marble, gold and a few precious stones.

The peculiarities of the climate of Japan are reflected in its flora, the palms, bamboos and ferns, reminding the traveller of the tropics; the pines, oaks, elms, laurels, beeches, walnut, &c., recalling the vegetation of Northern Europe, whereas the azalias, camellias and evergreen oaks call to remembrance the shores of the Mediterranean. The flora of Japan is said to be particularly rich and interesting, and would form a most interesting study for the researches of the scientific botanist, but as I have no pretentions to the above title, I shall confine my remarks to a few general observations.

As far as I have been able to ascertain from personal observation and study of various books, the principal forest species of Japan appear to be as follows:—

Metz (*Pinus Thunbergii* and *densiflora*), both of which species appear to be very common throughout the empire.

Hinoki (*Chamæcyparis obtusa* and *pisifera*), both of which species form extensive forest in the Central and Northern islands.

Suji (*Cryptomeria japonica*), found planted throughout the length and breadth of the country, and especially near villages and round all shrines and temples.

Keaki (*Zelkowa Keaki*), kuri (*Castanea vulgaris*), much used for railway sleepers.

21 species of oaks,

25 kinds of bamboos,

30 species of cherries,

many species being grown simply on account of their flowers.

Numerous kinds of azalias, camellias and laurels, besides various species of elms, maples, deutzia, hornbeam, viburnum, holly, olive, &c.

As regards characteristic plants of Japan, they may probably be enumerated as follows:—Azalias, camellias, *Cryptomeria japonica*, *Cydonia japonica*, chrysanthemums, Hibiscus, the Japan shrub peony, the famous water lily nasu (*Nelumbium surcifera*), asters, &c.

The principal forest trees common to Europe, which are mainly confined to the northern islands, are elms, beech, larch, aspen, wild cherry, ash, yew; whilst amongst shrubs and other plants, the following are most common, ivy, honeysuckle, lily of the valley, monkshood, marigold, wood sorrel, poppy, chickweed, dock and dandelion. Palms are by no means common, and are confined principally to the southern portion of the empire.

Regarding the fauna of Japan, as far as my limited observations went, animals and birds appear to be particularly conspicuous, by their absence.

However, an examination of the museums at Zokio and an inspection of the skins offered for sale, it appears that the principal forest animals of Japan are black bears, most common in the south, and brown bears, principally confined to the northern part of the empire.

A few polar bears are also occasionally found on the shores of the northern islands, brought there it is stated by the numerous icebergs which strand on the coast.

A kind of spotted deer is fairly common, also a wild goat, which, however, only inhabits the highest hills, and a few wild pigs are found, but they are by no means numerous.

Besides the above animals, which may be said to be the most important forest quadrupeds of Japan, there are foxes, badgers, monkeys, otters, wild cats, weasels, and hares.

As regards birds a large number of European species exist, such as crows, larks, robins, thrushes, geese, ducks, snipe and quail. There are also a considerable number of representatives of Indian species, such as kites, jays, barbets, parrots, &c.

There are two or three kinds of pheasant, the principal of which is of a beautiful copper color, and is much sought after by sportsmen. Owing, however, to the natural expertness of the natives at trapping and snaring, game is said to be scarce, this being also the opinion of several sportsmen whom I happened to meet.

Certain game laws have, however, now been promulgated, and shooting is only allowed at certain seasons.

Reptiles are not very common in Japan, and as far as I could judge from a rapid inspection of the collection at Zokio, they much resemble in general appearance those found in the Himalayas.

As regards fishes, the seas and lakes of Japan team with fish of all kinds, including several European species, such as salmon, trout, &c.

Consequently fish forms a most important part of the food of

the inhabitants of these islands, who are said to be most expert fishermen.

On approaching the coast of Japan one is struck by the immense number of native fishing boats which are generally seen trawling in pairs, but as many as seven are sometimes seen in a line dragging immense nets.

The first port touched by steamers from Hongkong is Nagasaki, situated on the south-west side of the island of Kinsin, the approach to which much resembles a picturesque Norwegian fiord. On the right entrance to the harbour there is a fine coal mine, one of the most productive in Japan, which fact renders Nagasaki one of the most important coaling depôts in this part of the world. The harbour is considered a safe one, and at the time of our visit it was occupied by seven Russian, French and British men-of-war besides numerous merchant vessels of all nations.

The principal exports from the town of Nagasaki are camphor, tea, vegetable wax, coal, &c.

As the P. and O. steamer remained in port for several hours, we had time to run on shore and examine the town, the European portion of which we found to be clean, well built, and much resembling a French town. The native part is also clean and prosperous looking, and the natives themselves are most civil and polite to strangers

As a rule throughout Japan even the poorest people are fairly well dressed, and few beggars are met with, either in town or country. The rural population and most of the inhabitants of the towns retain the national dress, which consists of a kind of long open dressing gown called a Kiminon, fixed round the waist by means of a sash.

The dresses of the men are generally of a sombre hue, blue being the color preferred, but those of the women are more lively, and especially on holidays are particularly gay.

The men generally wear hats of various patterns, the "Tam O'Shanter bonnet" being most fashionable, and the women do up their hair in a most elaborate manner. The ladies are also very partial to the use of chignons and large hair pins, and the fixing of their head gear is such an elaborate affair, that they recline with their heads resting on specially made blocks, in order that their hair may not be deranged. All wear wooden clogs of various shapes, but coolies and agriculturists generally wear straw sandals. During wet or cold weather overcoats of straw or oiled paper are generally used by the poorer portion of the population.

One of the most peculiar customs which first strikes the traveller in landing in Japan is to find all pack horses shod with straw. The shoes are fixed on in a simple manner, and as a matter of course only last one or two days, so that one finds horses' shoes strewn all along the roads in Japan.

The lion of Nagasaki is a hill called Sour, situated about three miles from the landing place, which is crowned by a temple and several tea houses, or small inns.

This temple is surrounded by fine clumps of elm, ash, pine, camellia, bamboo, camphor and cotton-wood trees, one of the latter being 30 feet in girth and 100 feet high.

After spending an hour or two pleasantly at this place, we returned to the steamer, and soon after steamed away for Kobi through the inland sea of Japan. Provided the weather is favourable and the traveller is fortunate enough to pass the best portions of the scenery by day-light, a sail through the inland sea must be very interesting, but on the occasion of my visit the weather was cloudy and misty, and some of the best parts were passed during the night.

However, we had a good view of that portion known as the Straits of Simonasaki and neighbouring islands, all of which are picturesque, and interesting.

The islands and coasts of this portion of Japan are all well wooded, principally with *Pinus Thunbergii*, oaks, elms and fine clumps of bamboo plantations.

Villages seemed to be few and far between, but those observed were well built, clean and flourishing. In their immediate neighbourhood considerable patches of neatly cultivated fields were to be seen, the principal crops being wheat, rape, beans and potatoes. Some of these fields situated on steep hill slopes are terraced in the same manner as in the Himalayas. The upper portion of the neighbouring hills are as a rule bare of tree vegetation, and the practice of firing the grass is evidently indulged in throughout Japan. No very satisfactory explanation of this practice was obtained, as cattle are seldom allowed to graze in Japan, and it is supposed that the firing of the grass is probably resorted to in order to get rid of an obnoxious kind of bamboo, and thus obtain a better crop of grass, principally for cutting for winter fodder, or for thatching purposes.

As a rule few cattle, except bullocks and cows, are kept in Japan, sheep being non-existent, owing it is said to the presence of a kind of bamboo which cuts up their insides, and goats and donkeys are also extremely rare. Nearly all the animals are stall fed, and during the whole period of my stay in Japan, I do not recollect of having observed an animal of any kind grazing in the jungles.

This happy state of affairs from a forest point of view, combined with an abundant rainfall, simplifies forest conservancy and plantation work very considerably.

Most of the inhabitants of these islands appear to be busily engaged in fishing, and numerous boats were everywhere passed, the fish caught being either salted or conveyed alive in tanks to the neighbouring large towns of Nagasaki or Kobi.

The run from Nagasaki to Kobi occupies about 40 hours, and as the latter town is not of much interest to travellers, I proceeded the following day to Kioto, the ancient capital of Japan.

The distance from Kobi to Kioto is about 50 miles, and the journey is easily performed in about three hours by means of a very well managed metre gauge railway. The railway plant for this line is said to have been manufactured by the Japanese themselves, and if so, the work has been done in a most creditable manner. All the officials are natives, and the traveller at once notes how appropriately the metre gauge system corresponds with the size of the men, both being in perfect harmony.

The principal timber used for railway sleepers in Japan is kuri (*Castanea vulgaris*), and they are said to last about 10 years. For the first 20 miles the line runs through an extremely fertile and well cultivated plain, having an average breadth of about 10 miles, the greater part of this area having been reclaimed from the sea or from the beds of the numerous water courses which traverse it. This has been effected by a complete system of embanking the sea shore, also the borders of about 20 streams which traverse this plain.

All these embankments, extending for about 5 miles inland, are substantially constructed on scientific principles, the sides next the streams being strengthened by willow planting, whereas the back slopes and neighbouring waste lands are all covered with pine and bamboo plantation. One peculiar feature of these embankments is the general use of bamboo baskets of various shapes, filled with stones, which are much used for protecting embankments in Japan. These are made in the shape of bolsters, about 20 feet long and 18 inches in diameter, and are laid horizontally along the foot of the banks, others of various diameters up to 4 or 5 feet being placed on end.

The principal town passed is Osaka, which is considered par excellence the trading centre of Japan, and also contains the mint and extensive barracks for the housing of the Imperial troops. Besides this place several other towns and villages were passed, the whole country on both sides of the railway being carefully and elaborately cultivated.

All the intervening patches of waste or high land are devoted to the cultivation of tea, bamboos or clumps of pines.

On approaching Kioto the line passes through a picturesque valley, the low hills on each side being completely clothed with flourishing forest of pines, oaks, *Cryptomeria japonica*, bamboos, &c.

It was satisfactory to notice that some kind of system in the working of these forests is evidently followed, the hard woods being cut on the coppice system, whereas the pines are either clean cut and the area replanted, or a few reserves are left here and there for the purpose of re-sowing these areas naturally.

The town of Kioto is probably still one of the largest, import-

ant and most picturesque cities in Japan, and not long since it contained upwards of one million inhabitants, but since the transfer of the Makado's Government to Tokio the population has naturally decreased. The streets of this town are well laid out and kept in fair order, but the houses and buildings are not of a pretentious nature, being generally not more than two storeys high.

This arrangement is necessitated by the frequency of earthquakes, and the houses are generally built of timber and bamboos with tiled or shingle roofs, and all have consequently a most inflammable appearance. The result is that conflagrations are of frequent occurrence, and the last great fire which took place in 1846 reduced in a few hours, 500 acres of the town to a heap of ashes.

Fairly efficient fire brigades are now kept in most towns, and tall posts are everywhere erected for the purpose of viewing and signalling fires, but notwithstanding all these precautions, all the most important shops are provided with their own fire-proof safes. These are built in a peculiar manner of bricks and mud, with very thick walls, and heavy iron doors, and within these buildings all the most valuable property is kept.

On an alarm of fire being given, the doors are closed and the joints plastered over with mud, and after a conflagration has passed over a section of a town, these buildings only remain standing alone amongst the smouldering ruins. The town of Kioto is famous for its temples, there being in all 350, the number of Buddhist and Shinto priests connected with these establishments being upwards of 15,000.

The most important of these temples is one called Hongwanji, which covers an area of about 30,000 square feet, and is about 100 feet high, the whole erection being of pine and elm timber. The interior of the temple is divided into variously sized chambers, the walls of which are tastefully decorated with elaborate carvings, paintings and lacquer work, &c.

One peculiarity of all Japanese temples is a kind of triumphal arch, called a Torie, which generally spans the entrance, and which consists of two upright and one horizontal beam painted or lacquered red. Another peculiar feature is the immense number of stone or bronze lanterns which generally line the entrance avenues, and are often from 10 to 12 feet high.

At the entrance to this temple there is an immense sacred Icho or Ginkyo tree, the scientific name of which is *Salisburia adiantifolia*, and which has peculiarly fan-shaped leaves.

In addition to *Cryptomeria japonica*, this tree is generally found planted near most temples in Japan, and is popularly supposed to pour out showers of water during conflagrations and thus protect the temples from taking fire.

In a fine grove of trees near the temple, we found several buildings inhabited by the priests, and surrounded by a neat

garden, which is ornamented with fish ponds, rustic bridges, stone lanterns, and trees and shrubs cut into fantastic shapes. In fact it is asserted that this style of garden, known as Dutch gardening, was borrowed by that nation from the Japanese

In the immediate neighbourhood we next examined the restoration of the great Shinagsi Honag temple, which was destroyed by fire about 7 years ago. The pine beams being used in the construction of this temple are of immense size, some of them being as much as 54 feet long and 2 × 2 feet square, from which fact some idea of the size of the forest trees of Japan may be gathered.

The carpenters employed on this temple building seemed to be very expert workmen, and all the most complicated joints were being used in putting the various scantlings together. For moving, raising and placing the beams in position various kinds of capstans, windlasses, pulleys and levers were being used in a skilful manner.

Amongst various ropes and hawsers employed on this work, I observed one about 12 inches in circumference and 100 feet long, composed entirely of human hair, and which we were told had been presented to the work by a devotee, this kind of rope being supposed to possess certain great advantages of strength, durability, &c., not combined in any other material.

Amongst various other interesting sights at Kioto the traveller is of course taken to see the numerous "curio" shops, some of which contain the most extraordinary collection of bronze and lacquered ware, weapons, pictures, &c.

Kioto is also famous for its porcelain and cloisonne ware, as well as silk and crape, but the prices demanded for all these articles is as a rule exorbitant.

Various interesting excursions may be made to places in the vicinity of Kioto, one of which, *viz.*, that to the rapids of Katsuragewa I found most interesting, and shall now endeavour to describe. These rapids are situated about 12 miles from Kioto, the first part of the journey being accomplished by means of Jinrikshaw drawn by two coolies, the distance being easily run over in about 2½ hours, even though the road was hilly and in very bad order.

Immediately outside the town of Kioto the road passes through an extremely fertile plain measuring about 10 × 5 miles, the whole of which area is cultivated like a garden. The crops, which consist of wheat, rape, beans, peas and other vegetables, are cultivated in ridges, placed about 1 foot apart, which arrangement enables them to be irrigated, manured and weeded in a most thorough manner. All kinds of manure from the city is conveyed to this ground in buckets and stored in the fields in small tanks or tubs till wanted, and everywhere in Japan, even in the most out-of-the-way places, I noted that no manure of any kind was wasted.

Intermingled with the crops and situated on the higher patches of ground one observes numerous patches of tea, the bushes being placed in continuous lines like hedges about 2½ feet high and 2 feet apart. These bushes are also manured in a most careful manner, and in some cases I observed bamboo screens or "tatties" constructed over them, in order, I suppose, to protect the tender leaves from the sun.

The low lying swampy ground is devoted to the cultivation of rice, the method of cultivation being essentially the same as that followed in India, with the difference that a plentiful supply of manure is given, and in consequence the rice produced is of first rate quality.

The villages passed through were remarkable for their clean, neat and flourishing appearance, the people being all industriously employed and apparently happy and contented.

The food of the poorer classes apparently consists mainly of rice, fish and vegetables, such as beans, peas, a large kind of white radish, sea weed and bamboo shoots. Tea is extensively drunk by all classes, also a kind of mild beer made from rice, called saki.

En route to the rapids we encountered numerous small hand-carts drawn by coolies or a single bullock, and ladened with various kinds of forest produce, such as logs, poles, planks, scantlings, charcoal, fuel, faggots and lime.

I observed that all scantlings and planks were particularly well sawn, some of the latter being not more than half an inch thick. All fuel was split and neatly sawn up into billets of about 18 inches in length, and during my travels in Japan I never noticed a piece of wood unnecessarily hacked with the axe, the use of the saw being thoroughly well understood.

All charcoal and lime is made up in bamboo or grass baskets of about 20 lbs. weight. The faggots also were particularly neat, and I observed several carts loaded with pine roots, which circumstance points to the economical manner in which forest operations are conducted in Japan.

We passed several extensive areas devoted to the cultivation of a species of large bamboo, the young shoots of which are specially appreciated in Japan as food.

These fields generally consist of patches of good land, the standard bamboos being cultivated as single stems situated about 10 feet apart, the heads being lopped off at about 12 or 15 feet from the ground, in order it is supposed to increase the number of shoots from the rhizomes, and reduce the shade as much as possible. The fields are carefully cultivated, and straw or leaf mould plentifully applied. The young shoots are cut or broken over just as they are appearing above ground, and large quantities were to be seen for sale in every bazaar, their taste when well boiled, very much resembling that of inferior turnips.

After leaving the plain of Kioto the road crosses a range of

hills through which a tunnel of more than 200 yards long has been recently constructed. All these hills are well wooded with pines, oaks and elms, the forests being it is said the property of the State.

Along the sides of the road, and for a considerable distance up the neighbouring slopes, a broad belt of *Cryptomeria japonica* has been planted by the Engineer in charge of the road, the plants being put in 5 × 4 feet apart, and the plantations seemed to be flourishing.

The geological formation of these hills being of a friable description consisting of shales, gravel and sand, the neighbouring slopes are subject to landslips, and in several places I noted that regular lines of fascines had been constructed along the hill sides. These are situated about 20 feet apart, the spaces between being carefully planted up with oaks, pines, &c., in a careful and intelligent manner. After crossing the pass the road leads through more villages, in the neighbourhood of which I noticed numerous oak trees carefully treated on the pollard system: also several temples, cemeteries and other enclosures surrounded by neatly trimmed bamboo and *Cryptomeria japonica* hedges.

On arrival at the bank of the Katsuragawa river, we entered a large flat bottomed boat about 40 feet long by 8 feet broad, manned by four sturdy boatmen, and at once proceeded down the rapids. The descent of this river must be somewhat exciting for those unaccustomed to this kind of river navigation, and considerable expertness is required on the part of the boatmen to avoid striking against the numerous projecting rocks, the stream being in some places a roaring cataract.

The total fall in a distance of about 7 miles is about 200 feet, and as there was a good supply of water at the time of our visit we performed the voyage in about 1¼ hours.

The central portion of the river is to a certain extent prepared for navigation, a rough channel being formed by means of removing the loose boulders, the laying down of cribs loaded with stones, also by a free use of the long bamboo baskets already described. The beauty of the scenery of this river is extremely picturesque and must be seen to be thoroughly appreciated. On each side the steep sloping banks rise up to about 500 feet above the river, the tops being covered with fine pine forest.

The lower slopes next to the river have been cleared of all timber, but it was satisfactory to observe that extensive planting operations of *Cryptomeria japonica*, pine, oak, &c., were in progress, the young trees planted being apparently flourishing.

The beauty of the scenery of this river culminates at a place called Arashiyama, when the boat was abandoned, and the Jinrikshaw mode of travelling resumed back to Tokio, which is distant about 7 miles.

At this place we found a large number of the pleasure-seeking

inhabitants of Kioto thoroughly enjoying themselves in various ways, *viz.*, boating, fishing, or sitting in groups in small booths engaged in eating, and drinking tea or saki, the whole festivity being mingled with a good deal of banjo playing, accompanied by rather discordant vocal melody. From this place, the road back to Kioto passes through some very fine bamboo plantations, as well as patches of tea, the country in this part of Japan looking thoroughly prosperous.

There are several routes by land from Kioto to Yokohama, but I preferred the sea passage, so retraced my steps back to Kobi, and embarked on board a fine Japanese steamer called the "Jamiashiro Maru," by which we arrived at Yokohama in 33 hours. This ship is one of a considerable fleet belonging to a Japanese Company; is manned by European officers, and has all the latest improvements including electric light. It is reserved by the Japanese Government as a transport in time of war, and is capable of carrying 1,200 men.

E. McA. M.

(*To be continued*).

VOLUNTEERS FOR SERVICE IN UPPER BURMA.

THERE will probably be some officers from the dryer climates of India who will find that the climate of Burma does not suit them. It is to be presumed that Government does not intend that those who volunteer for service in Upper Burma should suffer for their zeal, and I think, it would be but fair that they should be given the option of returning to the provinces from which they came, after, say, three years. Not in the class and grade to which they have in the meantime risen, but to their former position in the provincial list, where their names would still be retained, and they would be shown as "seconded." There is no doubt that promotion in the new province will be most rapid, in fact, most volunteers would ordinarily be sent on promotion; and those whom the climate suited would not care to go back to their provinces on reduction, as it were.

Three years' service in Burma would be obligatory, and after that each one would be called on to decide whether to come on to the permanent Upper Burma list or to return to his former province. The decision would be final, and, in the case of those electing to remain, their names would be removed from the other lists.

Otherwise, "volunteering" is likely to bear hard on some, and especially on those who come under the unfavorable leave and pension rules.

10th October, 1886. C.

JJ. Reviews.

REPORT ON THE ADMINISTRATION OF THE FOREST DEPARTMENT IN THE NORTH-WESTERN PROVINCES AND OUDH FOR 1884-85.

We owe an apology for so late taking upon us to discuss these reports, but the many items of interesting matter they contain, which our readers who are not able to see the original reports, may like to hear of, ought to find some record in our columns.

The Central Circle was managed as usual by Mr. Greig with the help of five Deputy Conservators and the Collectors or Deputy Commissioners of these districts. The areas thus administered are :—

Division.		Reserved Forest.	Protected Forest.	Other.	Total.
Naini Tal,	...	...	36	...	36
Ranikhet,	...	7	59	...	66
Kumaun,	...	636	...	...	636
Garhwal,	...	444	...	...	444
Ganges,	...	207	...	...	207
Jhansi,	...	37	...	...	37
Lalitpur,	...	140	4	...	144
Banda,	...	...	...	118	118
Total,	...	1,471	99	118	1,688

making a circle and a series of charges which Forest officers in provinces where the areas are far too big for them to do justice to, may well envy. But during the year the Naini Tal and Ranikhet Divisions were amalgamated into one. The Report unfortunately appears to give no information regarding the number of subordinates, Rangers, Foresters and Guards and the extent of their charges, although it says that a staff was sanctioned by Government during the year. It seems that at present there are no Rangers, and we suppose, therefore, that the forests are worked by a temporary staff.

To review the records of fire protection, so as to gain from them any information likely to be useful elsewhere is not easy, unless we can also give some account of the circumstances of the forests: we will, therefore, content ourselves with saying that 11 fires occurred, burning 531 acres out of 256,895. Climber cutting appears to cost on an average 1 anna 2 pies per acre.

Some very interesting tables are given of the measurements of sample plots of sál forest, the results of which are :—

			Trees.	Increase in girth, inches.	Per tree.
½-acre plots,	1.	Lachman Mandi, ...	65	27	0·42
	2.	Amtanola, ...	69	25·8	0·37
	3.	Sanmán Thapla, ...	56	10·3	0·34
2-acre plots thinned,	4.	Lachman Mandi, ...	114	95·3	0·83
	5.	Amtanola, ...	114	88·6	0·78
	6.	Sanmán Thapla, ...	115	70·3	0·61

showing the greatly increased growth in plots that have previously been carefully thinned of about one-fourth of their trees. The general results show—

Unthinned areas,	...	...	·38 in. per tree,
Thinned „	...	...	·74 „ „

the latter giving nearly double the increment of the former. At the rate of, say, ·74 inch per year a forest carefully treated with thinnings will contain at 100 years of age trees of almost exactly 6 feet in girth.

The next most interesting subject in this report is the account of the measures taken to check the waste and destruction caused by bamboo purchasers. The rule laid down was "no less than four uninjured growing stems to be left to each clump," and considering the usual difficulty which is experienced the first year, the results have been successful. We are not told whether cutting close to the ground, a point we consider of much importance, was attended to or not. The new rates for bamboos per 100 may interest some of our readers, they are :—

4 feet long,	...	...	...	Rs. 4
10 „ „	...	...	...	„ 9
12 „ „	...	...	...	„ 12
15 „ „	...	...	...	„ 15
20 „ „	...	...	...	6 pie each,

} per 100

the result being, not an increase of revenue, but that instead of taking immature and inferior kinds the purchaser takes only the better ones.

The Oudh Circle was managed, as usual, by Capt. Wood, with

the help of six Forest Divisional officers, the areas of whose charges are—

	Sq miles.
Pilibhit, ...	152
Bhira, ...	143
Kheri, ...	263
Bahraich, ...	325
Gonda, ...	154
Gorakhpur, ...	157
	1,194

reserved forest, with 1,211 square miles of protected forest, called the Katna grant.

The state of the subordinate staff appears to be no better in the Oudh than it is in the Central Circle, but at any rate it is satisfactory to find that Mr. Ponsonby considers that it is to the Forest School that they have to look for better Rangers and Foresters. Our previous impression was that, however near to it and in the province with it, few Circles in India were so backward in using the advantages of the school as were those of the North-Western Provinces themselves.

With the Inspector General's admirable 'Note' on the Oudh forests before us, we are absolved from making much remark on the working of the Oudh forests, for doubtless we shall before long be able to give our readers some account of Mr. Ribbentrop's remarks which, to our mind, constitute somewhat of a new departure, and at any rate bring to light facts regarding the illegal character of the forest settlements, which seem to show that the officers, Forest and other, who acted on behalf of Government at these settlements, did not display the amount of care and regard for Government interests that should have been expected. We are sorry that the remarks on grazing are so confused, but it is worth notice that 2·4 acres per head are allowed for 'privileged' cattle, and 6·2 acres for outsiders. Climber cutting in Oudh is more expensive than it is in the Central Circle, for it cost 4 annas 5 pies in Dudwa, though in Bahraich it was as cheap as 5¾ pies.

We have looked in vain for an intelligible balance sheet of the financial results of the Bahramghát saw-mill. We hope that another year we shall be told what the profit on its working was, after allowing for percentage of capital account, establishments and working charges.

The value of the School Circle Report is much diminished by the numerous 'errata'—on the other hand, a very useful map is a great assistance to an understanding of the report, which is much longer than those of the other Circles.

The School Circle was managed by Mr. Fisher, with three Forest divisions sub-divided into 14 ranges. But even the

School Circle seems to have difficulties in settling its subordinate staff.

The areas under the School Circle are :—

Division.				Sq. miles.
Dehra Dún,	...	...	...	277
Saharanpur,	...	...	...	295
Jaunsar,	...	...	...	192
		Total,	...	764

so that in all the three Circles contain an area of 3,616 square miles. Adverting to our remarks regarding the Oudh settlement, we note that the Conservator of the School Circle says that, "although there has been no formal inquiry into the *rights* of the people in the Dún and Saharanpur forests, yet their *privileges* have been duly recorded in the settlement papers, and are in no way overburdensome on the forests, and it has been plainly laid down by Government that no new *rights* can accrue in the reserved forest of the Circle" (the italics are ours). We should like very much to know under what section of the Forest Act power to record *privileges* was given to the Forest Settlement officers, or indeed to anybody. As we understand this sentence, Government has granted a series of privileges, at the same time laying down (and thereby setting itself above the Act which does the same thing) that *new* rights are not to accrue. Are we then to understand that it has deliberately elevated the privileges into rights, and bound down its successors not to institute any new one. We are far from saying that Government ought not to provide for the exercise of customary privileges, because they cannot be legally admitted as 'rights' in the meaning of the Act; but it should do so not by erecting them into legal easements but by providing for them by simple executive order alterable at its own will and pleasure. It is not conceivable that any private owner of land should deliberately burden his property with a series of easements which he and his successors could only get rid of by purchase in the future, when a simple permission conditional on good behaviour was all that was asked, and we do not see what difference there is when the proprietor is the Government.

The plans and sections of the Deota sledge road are given in this report. The work cost Rs. 3,598 for a length of 6,116 feet, and the saving effected is about 8 pies per sleeper brought out.

A series of experiments in the rate of growth of trees is recorded in para. 27, and these measurements are not only of sál, but of most of the common trees of the forests. They show that the mean growth is much slower in the Dún than it is in the Oudh forests, for at the rate of growth ascertained for Lakarkót (0·25 inches of girth yearly) it would take 288 years for the trees to reach 6 feet in girth, and this, as Mr.

Broun points out, shows that it will not pay to allow the trees to reach that size.

For the first time since the first year of its constitution, the School Circle shows a surplus revenue of nearly a lakh of rupees, due partly to the fact that during the year the Forest School and its expenditure were made Imperial instead of Provincial, and to a large saving in the cost of the sleeper works.

The financial results of the three Circles were :—

	Receipts.	Expenditure.	Surplus.
Central,	4,92,197	2,61,912	2,30,585
Oudh,	7,77,021	5,50,758	2,26,263
School,	3,02,801	2,07,432	95,369
Total,	15,72,319	10,20,102	5,52,217

The review by the Government of the Province is long and interesting, and that of the Government of India expresses itself as pleased with the work done.

TIMBER COLLECTION AT THE BENGAL ECONOMIC AND ART MUSEUM.

THE following extract from the report of the Bengal Economic and Art Museum for the past year will interest our readers :—

"*Timber collection.*—The Timber Court occupies the wooden annexe facing the Chowringhee Road to the north of the main entrance to the Imperial Museum. As stated in the last progress report, this collection comprised at the close of the last year some 2,000 specimens of Indian woods forming one collection, and 578 specimens forming a second, and also sundry smaller collections of wood from other countries which had been presented to the Bengal Government at the close of the exhibition. The two thousand specimens of Indian woods which had either been shown in the Calcutta International Exhibition or had belonged to the Economic Museum, had to a certain extent been systematically arranged on the following plan :—In every case, so far as was possible, the name of the tree yielding each specimen block was ascertained, and it was then referred to its proper botanical natural order, and the specimens were grouped according to the natural orders to which they belonged, the arrangement of the natural orders being the same as that followed by Mr. Gamble in his 'Manual of Indian Timbers.' This arrangement is undoubtedly most valuable from a scientific point of view, and it is the one best calculated to show the connection between the woods yielded by the trees of the same natural order, and it is also the arrangement probably that would be preferred by any one making a systematic study of the subject. On the other hand, the arrangement might have appeared to be a little puzzling to casual visitors to the collection. It was, however, fortunate that the second collection of 578 specimens of wood which

had been exhibited at the Edinburgh Forestry Exhibition was handed over by the Bengal Government to the Museum. This collection was arranged alphabetically, and it could, therefore, be used as a kind of index to the larger collection, and with this system, which amounts practically to one of cross reference, no one could have any difficulty in studying the subject of Indian timbers.

"During the first five months of the year under review, the work of identification, systematic arrangement, and classification and labelling and re-labelling of the numerous Indian timber specimens was most vigorously pushed forward, and by August this Court really represented a most systematic and valuable collection of Indian woods, carefully labelled with all available information with their botanical and vernacular names, place of growth, &c, and in such a way that information about the majority of Indian timbers could be very easily ascertained. When this work was virtually completed, orders were received from the Government of Bengal (No. 1804—228 Mis. F, dated 13th August, 1885) to make over the collection of timber specimens to Mr F. B. Manson of the Forest Department for the purpose of constructing a triumphal arch for the Indo-Colonial London Exhibition. Mr. Manson in this matter was acting for the Government of India, and he had to construct the arch on behalf of the Revenue and Agricultural Department. Mr. Manson therefore took charge of the timber collection in September 1885, and from this time the Timber Court of the Museum has had to remain closed.

"The total number of wood specimens which were in the first instance handed over to Mr. Manson was 1,952, but 254 specimens were subsequently returned early in 1886. The actual number of specimens of Indian wood belonging to the Economic Museum, which have been used in the construction of the triumphal arch, is 1,698, and it will be seen that these form practically almost the whole of the collection. The specimens were only handed over on loan to the Revenue and Agricultural Department, Government of India, and at the close of the exhibition they will have to be returned to the Museum. In the construction of the timber arch other specimens of wood were used as well, but it would appear that the main part of the surface of the arch has been made of the specimens belonging to this Museum. If the beautiful triumphal arch which was constructed is handed over to the Museum at the close of the exhibition as it is, it will undoubtedly form a very handsome addition to the Timber Court; but arranged in that way, the specimens of wood will be of little value for scientific study, and it will be impossible to give the names, localities, &c., of the specimens when thus forming part of the large structure. It must also be mentioned that in many cases Mr. Manson found it necessary to alter the shape of the specimens of wood for the purpose of fitting them into the various ornamental and geometrical designs with which the arch is decorated. The labels giving the scientific and vernacular names of the specimens had also to be removed from the specimens, though index numbers were stamped on them so that they can be still recognised, and thus to utilize this collection in its former way would necessitate much labour in making the specimens uniform, in re-labelling, and in other ways, and even when thus re-labelled, the alteration in the form of many of the specimens will have much deteriorated the value of the collection. Assuming then that the triumphal arch will

be returned as such to India, and that it will be returned to the Museum, and that it will be considered desirable to exhibit it in Calcutta in this form, it may be suggested that the Forest Department should be asked to provide the Museum with new typical collections of Indian timbers to replace those which have thus been done away with, and that such typical collections should be arranged as the collections in this Museum were formerly arranged.

"The only addition to the timber collections which was made during the year under review was a collection of 30 bamboos from various parts of India, which was handed over to the Museum by Mr. F. B. Manson, who was also engaged in preparing a bamboo trophy for the London Exhibition under the orders of the Revenue and Agricultural Department, Government of India."

III. Notes, Queries and Extracts.

Forestry in England.—Although in your interesting article—which I have read to-day with close attention—you very frankly criticise the proposal to establish a School of Forestry in England, I am sure you do not wish in any way to injure the admirable movement identified in Parliament with the name of Sir John Lubbock. I fully admit many of the difficulties which you point out as existing in the way of the establishment of such a School of Forestry as is suggested; but I think you rather overrate the value of our foreign supplies of timber. Those supplies, I will readily allow, are abundant enough now, and home growers know well how keen is the competition between home-grown and foreign timber. But it is too generally lost sight of that the drain upon foreign timber reserves is enormous, and that, taking the world at large, there is nothing like a compensating process of planting going on to repair the gigantic losses which the world's forests are sustaining in order to supply the wants of civilised nations.

You mention amongst other sources of supply, the primæval woods of America. Not many years since the timber supply of the American Continent was considered practically inexhaustible. But what is the case now? A timber expert—Mr. James Little, of Montreal—writing in 'Forestry' not long ago, estimated, as the result of a very careful calculation, that there was not more than a seven years' supply of merchantable timber in America. Not only for a long time past has there been an enormous drain upon American timber resources to supply the needs of the world, but the practice of cutting was most improvident and reckless. To get at a particular "big tree," scores of small trees that would, undisturbed, make the forests of the future are ruthlessly destroyed. The Americans have hardly yet realised that their own needs will shortly compel them to close their ports against the export of timber, and other countries are likely to follow their example under similar and by no means far distant circumstances. What would then become of the timber question in this country? It would become a question of the first importance, and the price of timber would rise enormously, and no longer admit of any unfavourable comparison with wheat and other corn growing. Counter considerations as to game preserving would then, I think, go to the winds.

I am perfectly well aware that the slow growth of timber—that is, of most kinds of timber—prevents a prospect of immediate profit. But it is nevertheless the fact that there is a large

quantity of uncultivated land in this country upon which nothing else than trees of a certain kind can be grown. This remark applies with peculiar force to large portions of Ireland. In view, therefore, of the probable arrival of a timber famine at no very distant date, it behoves us in this country to give every encouragement to a movement whose object is not merely to establish an English school of forestry, but to give an impetus to timber planting throughout the world.—FRANCIS GEORGE HEATH.—*Standard.*

Underwood, Kew Gardens, July 12.

METHOD OF PRESERVING TIMBER IN JAPAN.—Now that we are getting Tea boxes from Japan, the following extract from the "Journal of Forestry" will be interesting. Be it noted, then, that the Japanese use only wood previously preserved as follows :—

Preservation Process applied to Timber.—At a distance of 20 or 30 chos (1 cho = about 120 yards) from the sea, and near the mouth of a stream, a large pond is dug, so that the sea may have free access to it. This is called Kakoitori (or storing pond). Its size is not fixed, but generally it contains an area of 14,000 or 15,000 tenbos (1 tenbo = about 36 square feet), and its owner keeps his office near by, so that he may transact his business on the spot. The circumference of the pond is built of stone or wooden walls, and a canal is dug on one side to communicate with the river, and thence with the sea ; the flow of the tide being regulated by means of a sluice. The pond should not be deeper than 5 feet in the central parts at full tide, and not shallower than 2 feet in the margin at ebb tide. The right proportion of salt and fresh water for the pond is six parts of the former to four of the latter, for if the salt water exceeds this proportion timber becomes blackish in colour, and is liable to be much eaten by worms ; if, on the other hand, the proportion of salt water becomes less, it is much sooner decayed than otherwise. The velocity of the flow of tide should also be very carefully regulated, for if the current is either too rapid or too slow, timber is again very liable to be much injured by worms. Hence in those places where there are two or three ponds near one another, their owners generally amalgamate them, on agreement, by means of small canals, which arrangement regulates the flow of tide very considerably. Timber for storing is usually piled in five layers according to its quality ; the lowest layer consisting of middle class timber, the next layer of first class timber, the next layer above again of middle class timber ; the next layer of third class timber ; whilst the uppermost layer, which is usually exposed above the surface of the water, consists of very low quality, and by its weight the lower four layers are kept sunk under water. Those five layers are piled one upon

another alternately at right angles, so that the whole arrangement presents the appearance of a toothed cube. Sometimes, however, the pile consists of only two or three layers; in that case they are tied to a big log (about 12 to 15 feet in length, and 7 or 8 inches in diameter) standing near by, and are thus prevented from floating about freely; sometimes also one or two separate pieces of different kinds of timber are kept in the pond for specimens. The durability of timber depends greatly on the amount of care bestowed on it, and to this end the washing is the most important. Twice in a year, generally in June or November, the cubical mass of timber above described is disengaged, and each piece is well washed by means of a straw brush. The different pieces are then reconstructed in a cube, but with the following alteration in the arrangement:—The middle-class timber, which before constituted the third layer, now forms the lowest layer, and the middle-class timber which in the former case was at the very bottom, now occupies the third layer. If washing cannot be done twice a year, it must be performed once a year at least. In the following table are shown (in the first column) the names of different kinds of timber, in the second column the number of years for which they may be preserved in the timber store, and in the third column the period at which they are best adapted for use:—

I		II.		III.
Hinokai (*Thuia obtusa*),	... ...	for 8	after	3
Matson or Momi (*Abies firma*),	... ...	„ 4	„	1·5
Sugi (*Cryptomeria japonica*),	... ...	„ 5	„	2
Tsuga (*Tsuga Sieboldii*),	... ...	„ 6	„	2
Hiba (*Thuia dolabrata*),	... ..	„ 8	„	3
Tawara (*Thuia pisifera*),	.. ...	„ 8	„	3
Keyaki (*Zelkowa Keyaki*),	... ...	„ 8	„	3
Kashi („ „)	... ...	„ 10	„	4

(The number of years is calculated from the day of felling, and the time which is spent before timber comes to the store is reckoned to be one year).

A pond of 15,000 tenbo in area can, on the average, store up about 10,000 pieces of timber. They are of various lengths, as the following figures show:—

Lengths of timber (in kens) 2, 3, 2·5, 4, 3·5, 4·5, 5·6.
Percentage number 50, 20, 10, 5, 1·0, 5, per cent.

Thus one-half of the whole timber in the pond is of 2 kens in length, one-fifth is of 3 kens in length, &c. (1 ken = 2 yards).

At ordinary times, only three or four men are employed, whose daily wage is 30 to 45 kus (?), but at the washing season fifteen men are employed daily for a period of about half a month.—*Gardener's Chronicle.*

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THE FOREST CONFERENCE AT DEHRA DUN.

ALL of us who were at the Forest Conference, held in October 1886 at Dehra Dún, will allow with pleasure that the freest discussion was encouraged on all matters laid before the officers there assembled, and we may hope with reason that our meetings will bear good fruit in many ways. As a matter of course our observations and proposals were limited to what was immediately before us, and the Government in allowing us to meet and discuss the state of the Department and its wants expected us to keep within the four corners of the programme drawn up. In the pages of the "Indian Forester," however, we may expatiate more according to our own wills, and raise discussions which may possibly reach further.

I wish to carry to a higher point the discussion on the position of District Forest Officers, and to make suggestions regarding the organization of the Forest Department in its higher branches; to say a few words regarding the training of its controlling officers, and to point out what good purposes the Forest School at Dehra Dún may be put to.

The present system which gives a Conservator, with a varying number of officers under him, to each of the more important charges can be greatly improved. In all thelarger charges, at least, there should be a *Chief Conservator*, who should also be *Secretary to the Government in the Forest Department*, and he should be the sole administrative head under his Government and responsible to it alone. Under him should be *Conservators*, each in charge of a *Circle*. These Circles should be no larger than can be thoroughly well supervised, controlled and inspected by the Conservators, and should be divided into *Charges*, each under a controlling officer who should be placed in close accord with, and work under, the District Civil Officer in carrying out the scheme of forest management, which scheme, in all professional, financial and disciplinary matters, must be subordinate to

the orders of the Superior Forest Officers. Each charge should be divided into *Ranges*, each under its own *Ranger*, and the Ranges into *Sub-Ranges* and *Beats* under *Foresters* and *Forest Guards*.

The unit should be the Range, and the number of Rangers contemplated by Dr. Brandis for all India at, I think, 1,500 is not too large. The Rangers will, of course, be all men trained at, and passed out by, the Forest School. Given such Rangers and Ranges of manageable size the forests will be well protected, worked on proper principles, and *the revenue will increase to a vast extent.* Such Rangers will necessitate a very much higher standard of knowledge than is at present apparent among Sub-Assistant Conservators; and it goes without saying that the officers who again control the Sub-Assistant Conservators and junior controlling officers must also be men possessing a really good general education and high special attainments. But such controlling officers will be discouraged, and their usefulness much limited unless they are placed in suitable positions, and unless they have large Departmental powers.

The Forest Department is now no longer in its infancy. It yields a large gross revenue with a very handsome surplus, and is daily increasing its capital and growing stock. The work to be done is not only special work, but is now organized and growing in importance. This is why we may ask that Conservators be placed in a higher position and in much closer contact with their Governments and Administrations. To do so will increase their efficiency, increase the revenue, maintain a higher standard of forest work, and so benefit the public estates and the public. These officers should be more independent, and be allowed to approach their Governments more directly, than is now possible, when they have to send up schemes and to receive orders through other channels which, however able, are still unprofessional. There are now, in the existing Forest Acts and in the means which every Government has of obtaining the opinions of its chief Civil officers, ample safeguards to prevent the undue preponderance of a Department. But when such opinions have been obtained and sifted the Government should deal directly with the head of the Forest Department as its administrative officer *and Secretary* in that branch. No practical difficulty exists which need prevent the initiation of such a measure. The men are there, among the Conservators, and among the officers who having done well at the German and French Schools of Forestry can now claim much Indian experience and a capital record of work done.

Some such scheme appears to be now needed. Each province should have its single administrative forest chief. Putting two or more Conservators into a province, each with equal and inadequate powers, and all of them under a Financial Commissioner, or a Board, or a Secretary, is not a good plan.

Next with regard to the training of the controlling staff. It is a pity that the age at which young men are sent out is not higher. It should be raised and a higher general education called for. After going through a special theoretical course at Cooper's Hill, the officers intended for the controlling staff should be sent to the Dehra Forest School to go through a two years' course there. Indian experience is what they want, and a practical training in Indian Forestry. At the risk of being classed with those you lately called "some conservative members of the Department," I cannot but say that my experience has shown me that, in the majority of cases, the young men sent out through Nancy have been of but limited use till they had gone through a somewhat lengthened experience out here. I do not wish to be misunderstood. I am not despising their training there, but it was all too short, and much of it gained in forests very unlike what most of them have to deal with here. And, except at the beginning of the system, they have come out too young. It may be objected that to raise the age for entrance and to prolong the course means money. India is not the place it once was, but yet it presents a fine field for Englishmen, and is still the land where the finest service can be found. With the hundreds of educated men at home who, if all one hears and sees and reads is true, barely succeed in gaining a livelihood, it is probable that fair pay and a position suited to their talents would attract men from the Universities. But they must be certain of fair pensions, fair furlough rules, and not be liable to changes in rules and to seeing others, with no higher education or talents than themselves, placed under better rules. In fact, the Forest Officer of India should be a member of the Covenanted Civil Service, and the Department should become an integral part of that service, and with prizes sufficient to keep men in it.

The Forest School at Dehra is, with the staff that we had the pleasure of meeting in October last, quite able to instruct any men who may be sent to that institution, and it does seem a waste of power that this well manned and well furnished and well housed School should not be utilized to a far greater extent than it now is by the Government. It should, under well considered regulations, be thrown open to the public, and in that case I believe that the School will not only turn out an ample supply of good forest officers for India, but also for other parts of the Empire. Australia, New Zealand, the Cape, Mauritius, Egypt even, are all in want of such men, and the Dehra School, with the pine and oak forests of the Himalayas on one side, and the varied forests of the plains on the other, is *the* place where the widest experience can with the greatest facility be brought to bear on practical forest training.

There is one point more on which I would touch. The pay and position of the Inspector General of Forests is lower than it should be, when the very responsible and heavy duties that he

has to perform over the length and breadth of India are considered. He draws less pay than a Collector of a single district. This seems to be an anomaly.

G. J. vS.

A TOUR IN JAPAN.

(*Concluded from page* 518).

YOKOHAMA is quite a European town, with good public buildings, hotels and fine private residences. Along the coast to the south-west of the town stretches a range of low hills, called the bluffs, on which the principal inhabitants live.

These neat English looking houses are surrounded by well kept gardens, adorned with many tinted azalias; camellias, and other Japan or European plants and flowers. In the public garden at Yokohama many experiments have been made with the cultivation of exotic trees, and I noticed a large nursery bed of deodar, also others planted out, all of which seem to be thriving.

From Yokohama we proceeded to Tokio, the new capital of Japan, the railway running through a highly cultivated piece of country bordering on the sea, with many orchards and low hills all well clothed with pine and bamboo forest or plantations. A large river is crossed "en route" by means of a fine iron bridge, down whose stream a large number of rafts of pine timber are continually passing from certain forests situated in the hills above. These rafts are constructed about 150 feet long and 15 or 20 feet wide, and contain several hundred logs and poles of various dimensions.

The city of Tokio covers an area of about 70 square miles, and was for a long time popularly supposed to contain more inhabitants than London, but this has been found to be a delusion, the total population, according to the latest census, probably not exceeding 1¼ millions.

The general appearance of Tokio is somewhat disappointing to the traveller who has visited Kioto, the houses being generally low and unassuming, but there are several fine public buildings, also one fine street or boulevard called the Shimbashi.

Lines of trees are being planted along the sides of this boulevard, and I noticed a large pine about 50 feet high and 6 or 7 feet in girth with roots complete, being transplanted by means of a truck drawn by eight strong oxen. Tokio is famous for the number and extent of its public parks, which are generally situated on rising ground, the principal of which are Shiba Ueno, and the grounds of the Makado's palace.

At the first of these, embosomed in a fine grove of *Cryptomeria japonica* trees, may be seen the tombs of several of the

Shoguns or Tykoons of Japan, together with several fine temples elaborately carved and lacquered, the avenues leading to the shrines being lined with rows of large stone or bronze lanterns of fantastic shapes.

Through the kindness of the British Minister at Tokio, I obtained a letter of introduction to Mr. Marimpsa Cakie, Chief Commissioner of the Department of Agriculture and Commerce, also "Chef de l'administration des forêts du Japan," who I found most civil and obliging in giving me information regarding the forests of that country. Amongst various other matters which formed the subject of our conversation, I was agreeably surprised to learn that a College of Forestry was started about four years ago at Tokio, which establishment we proceeded to inspect, and a description of which I shall now endeavour to give.

The College is situated in what appeared to be the suburbs of Tokio, and consists of 10 or 12 separate buildings, which comprise lecture halls, museum, professor and students' quarters, cook houses, &c.

The Director, Mr. Matgumo Hazama, appears to be an intelligent man, and he took great pleasure in showing us round and explaining everything. He has visited various Forest Schools in Germany and studied forestry there, so that as a matter of course, the Japan Forest College has been established on what may be called German principles.

The establishment consists of 10 Professors, and there were about 130 students attending the College at the time of my visit. The course as at present arranged extends over 5 years, 3½ being devoted to instruction at the College, including holidays, and 1½ years to practical work in the forest. The age at which the students enter the College is 18 years, and the successful candidates at the final examination are eligible for posts of 25 Dollars, or about Rs. 55 per month, in the Japanese State Forest Department, which is now in course of organization.

The buildings in connection with the College consist of timber and bamboo structures with shingle or iron roofs, and everything appeared to be neatly arranged, clean and suitable.

There are eight class rooms devoted to lectures on forestry, mathematics, natural sciences, chemistry, surveying, &c., together with an extensive laboratory for the chemical analysis of soils. All instruction is of course conducted in Japanese, but the figures used for all calculations are English.

The students live in separate quarters in the same compound, four men occupying each room, some of which I examined and found them neat, clean, and serviceable. All the students dine together in a large hall provided with long tables and chairs, and are charged 5 Dollars, or about Rs. 12 per month, for board and lodging. They are not allowed to leave the premises without a pass, but I observed four small reception rooms with

kitchens attached, where the students can see their friends and entertain them if they choose.

There is a very fair museum attached to the College, which contains a fine collection of about 200 Japanese woods, and above each section, I noticed a neatly framed and glazed complete botanical specimen of the species. There is also a good collection of seeds and forest products of all kinds, including manufactured articles, such as clogs, tubs, large vats, &c.

A zoological collection has also been commenced, and a few of the Japanese animals, birds, beetles, butterflies and other insects have been got together. The homely sheep is considered such a rare animal in Japan, that it finds a prominent place in most museums.

Amongst various curious and interesting objects I was shown a large and well made model of the Kissu reserved forest, which is situated about 100 miles north-east of Tokio, and as far as I could learn, it appears to be the principal State forest at present being worked in Japan. A series of well executed pictures of forest lumbering works at this reserve, and in the forests of the great northern island of Japan near Hakodadi were also exhibited, from which I formed a very favourable opinion of the expertness and skill of the Japanese as lumbermen.

The Kissu forest is stated to comprise an area of 35,000 acres, and consists principally of Hinoki or (*Chamæcyparis obtusa* and *pisifera*), and from the pictures above referred to and the explanations furnished by the Director, it apparently contained trees of very large dimensions, probably as much as 18 or 20 feet in girth. These pictures represent the felling of immense pines by means of the saw, axe, or by fire, in some cases the tops and side branches having been removed, and the fall directed by means of three or four stout hawsers attached to rough capstans.

Other plates showed trees being felled on rocky ground, a thick bed or platform of branches being constructed in order to break the fall as much as possible. The squaring, sawing and transporting of logs 30 or 40 feet long and 2 × 2 feet square, by means of elaborately constructed timber slides, was also represented, the ground as shown in the pictures being of the roughest nature.

The floating of timber down mountain torrents was well illustrated, and several kinds of dams, sluices, and other contrivances common in Germany were also shown, and which I understood the Director to say had been in use for many years in the State forests of Japan. Other plates represented the lowering of logs by means of pulleys and capstans over precipices, also sliding timber down steep slopes in the snow, the front part of the logs being supported on small sledges, and the back end being left as a drag. At the point where the mountain streams "débouche" on the plains a serviceable boom is employed to catch the timber which is well represented in the

plates, and I could not help observing that the place and general arrangement very much resembled those at Dakh Pathar on the Jumna. By means of this boom the logs are directed into a bay surrounded by piles, where they are kept afloat till it is convenient to raft them down the Tenrin-gawa river to the sea coast. Mr. Marimosa Cakie was most anxious that I should visit the Kissu forest and see all those interesting works for myself, but as the trip would have occupied 8 or 9 days, the time at my disposal did not permit my doing so. No regular system of felling seems to have been followed till lately at this forest, and all the best timber is said to have been removed.

The total area of Government forest in Japan at present reserved, is stated to be only about 3,000 square miles, but no very reliable information on this subject, nor on the question of revenue or expenditure, was forthcoming, nor have the reserves been yet demarcated.

Certain laws and regulations regarding forest conservancy, and especially with regard to the protection of game exist, and it is satisfactory to learn that fire protection is considered so important, that a special clause prohibiting the lighting or carrying fire in all forests is entered on the passports with which travellers have to be furnished whilst travelling in Japan. After several days spent at Tokio we started for the famous shrines of Nikko, situated about 90 miles to the north.

The first part of the journey was performed by train to a place called Utsumaya, the line passing through an undulating and highly cultivated country, all the low hills and considerable portion of the plains land being covered with patches of pine (*Cryptomeria japonica*) and bamboo forests and plantations.

These patches of woodland, the areas of which vary from 5 to 50 acres, and which probably belong to temples, villages and private individuals, are apparently well looked after, and all rank undergrowth and refuse wood removed.

The importance of growing timber and fuel is thoroughly understood and acted up to by the people of Japan, and all waste patches of land in the vicinity of villages are invariably planted up. As a rule, all trees are planted close, so that no pruning is wanted, and clear felling for the coniferous trees, and coppice for the hardwood species seems to be the system in force. As regards the treatment of bamboos in Japan, I never observed any growing in clumps, all stems being invariably situated not less than 2 or 3 feet apart, and distributed in a most regular manner over the whole area.

All kinds of forest produce are thoroughly appreciated in Japan, and the best means of growing the materials most useful for the general public is well understood. It must, however, be admitted that on account of the comparatively mild climate, favourable soil, absence of grazing and plentiful rainfall, distributed over nearly all the months of the year, the planting and rearing

of trees in Japan is a very simple matter, in comparison with the difficulties to be contended with in India.

From the end of the railway to Nikko, distant 22 miles, the journey was performed by means of native carriage, the road being lined the whole way by magnificent avenues of *Cryptomeria japonica* and *Pinus Thunbergii*. These trees are ranged in stately rows on each side of the road, the average girth being about 12 feet, height about 120 feet, and the total number of trees per mile is probably not less than 1,000.

These trees are said to have been planted about 250 years ago by a devotee, who being unable through poverty to add to the shrines at Nikko, decided to show his veneration for the great Shoguns buried there by planting this avenue, and if the tale is true, he certainly could not have left a more conspicuous and lasting memorial.

At Nikko we put up at a native tea house or inn, there being no European hotel there. These houses, which are extremely common throughout Japan, are generally two storied edifices constructed of wood with shingle roofs, the interior being divided up into small rooms by means of sliding screens composed of wood and oiled paper. By the removal of these screens, which is easily effected, rooms of larger dimensions are made at pleasure. All the floors are covered with well made soft mats, the whole of the premises, including the kitchen, being kept scrupulously clean.

The wants of the traveller are promptly and cheerfully attended to by polite waitresses, who are always neat, civil and obliging. There are no bedsteads in these houses, but by the aid of numerous thick rugs, which are kept in stock, the tired traveller finds the floor quite soft enough.

Every tea house has of course its trimly kept garden attached, where one generally sees a fish pond, a waterfall, a rustic bridge with miniature paths, the trees and shrubs being trimmed and often dwarfed so as to suit the surroundings. In fact some of these gardens are arranged on such small proportions as to give the effect of an extensive park viewed from a distance through the large end of a telescope.

The temples or shrines of Nikko, which are dedicated to the memory of two of the greatest Tykoons or Shoguns of Japan who are buried there, are situated in the middle of a magnificient *Cryptomeria japonica* grove occupying several small hills and valleys, the total area of the forest being about 300 acres. The average girth of these trees is about 12 feet, but one tree observed measured over 24 feet in circumference. The height of the trees is about 125 feet, and as far as I could ascertain from the examination of a few stumps, their age appears to be about 500 years.

There is no young growth of *Cryptomeria japonica* in this grove, nor did I observe any natural reproduction of this species

anywhere in Japan. There are in all at this place 29 temples, pagodas and other buildings connected with the shrines of the two Tykoons who are buried on the tops of two of the small hills. These temples are constructed of timber after the most fantastic and artistic designs, and all are elaborately gilt and lacquered all colors of the rainbow, so to speak. They are also decorated with fine carving and bronze work of the most curious description, and at every corner one encounters red, blue, yellow and green demons of gigantic proportions and ferocious aspect.

There is a Japanese saying, which is to the effect, that until the traveller has seen the temples of Nikko he is not entitled to use the word Kikko, which in Japanese means beautiful or splendid, and it must be confessed that although we saw these temples and shrines under the somewhat depressing influence of a Scotch mist, we agree that the praises bestowed on this charming spot by all who have visited it, are by no means exaggerated.

After having thoroughly examined Nikko and its vicinity, we started for the lake of Chiwzinji, situated 10 miles further up the mountain at about 4,000 above sea level. The road up leads through several extensive forests of oak, elm and maples interpersed with numerous clumps of *Pinus parvifolia* and other conifers.

At about 3,500 feet elevation a number of beeches and birch trees were encountered, some of the latter being about 8 feet in girth. Amongst other shrubs the azalias were particularly conspicuous, and hundreds of acres of the hill sides were tinged pink by a species which was in flower at the time of our visit.

The road up is a well constructed 6 foot path, the mountain torrents being spanned at intervals by well constructed rustic bridges, and several waterfalls are passed, some of which are of considerable height.

The lake of Chiwzinji is about 12 miles long by 2 miles broad, and has probably at one time formed the crater of a volcano, lava and ashes being everywhere met with on its banks.

The lake is dominated by a volcanic cone called Chirani, which attains an altitude of 8,000 feet, and was in active eruption as late as 1870.

The scenery of the lake even at the end of April had rather a wintery appearance, the trees being still leafless, and wreaths of snow were lying about in the forest at the time of our visit. We put up at a tea house situated on the edge of the lake, which we found somewhat cold, and more suited for summer than for spring weather.

Early next morning we crossed a low pass and walked down a rough forest path, about 12 miles to a place called Ashimo, where our Jinrikshaws were awaiting us.

At this place there is a large copper smelting furnace, in connection with the fuel supply to which extensive forest operations were being carried on in the neighbouring hills through which our path lay. These consisted principally in the preparation of large quantities of charcoal, which was being manufactured in large kilns of the following description.

The kilns are made of rough masonry about 6′ × 6′ inside measurement, and are vaulted over a small door, about 5½′ × 2′ being left.

The billets of hard wood are cut about 5 feet long, and if the logs are more than 9 inches in diameter they are split in half. These were carried through the doors by the charcoal burners, and closely packed on end, a certain quantity of inflammable material, such as leaves and branches, being added. The door is then built up, two small openings for air being left, and after 24 hours baking the charcoal is raked out and extinguished by pouring on water, a plentiful supply being of course required for this mode of manufacture.

The charcoal is removed from the kilns on coolies backs, who carry immense loads, and is taken to a depôt lower down, where it is stored in large thatched godowns, from whence it is transported in two wheeled hand carts to the furnace situated about 3 miles lower down the valley.

Large quantities of fuel were also being cut and stacked, the billets being all sawn into 2 feet lengths. The fuel after being measured up was being floated down the mountain stream, which had evidently been prepared for the purpose to a point situated about half a mile above the factory, where it is caught by means of a large dam. It is then transported along a canal, which in addition to floating the fuel, also turns an immense water wheel which drives the machinery used for crushing the copper ore.

Large quantities of the manufactured copper prepared at this factory is exported to India, and a limited quantity even reaches London. The forest where the fuel operations for the supply of this furnace were in progress is said to be the property of the State, and is leased by the owners of the foundry, and as might be expected, the fellings were being conducted in a very unsatisfactory manner, whole hill sides being swept bare, also traces of fire were everywhere apparent. I was informed that the intention of the Government is to plant up the whole area with *Cryptomeria japonica*, but owing to the denuded nature of the ground the operation, even under the favourable Japanese conditions, will not be an easy one.

The next day on our way to Haigo, which is the nearest railway station, we passed through many flourishing villages, in the neighbourhood of which we observed numerous plantations of *Cryptomeria japonica*, oaks and other hardwood trees.

The plants necessary for these operations are obtained from well kept nurseries, one or two of which I noticed in the neigh-

bourhood of most villages. Tree plants are also regularly sold in the bazaars, where one sees them offered for sale tied up in neat bundles containing 25 to 50 plants according to their size. Besides trees, flowers in pots are largely sold in the bazaars, the Japanese being thorough appreciators of the beautiful. One also sees curious dwarfed plants offered for sale, and a pine or *Cryptomeria* and an oak 15 to 20 years old, may be obtained in a box measuring a few inches square.

In passing through these villages I was agreeably surprised to notice that the packs of useless dogs, which as a rule infest all Indian villages, were conspicuous by their absence in Japan, and only well regulated dogs, provided with collars, on which the names of the owners are inscribed, are apparently allowed.

This portion of Japan is a great silk producing district, and numerous plantations of mulberry trees were observed. These are generally treated on the pollard system, the trees not exceeding 5 feet in height, and all are carefully looked after and well manured. On approaching Haigo, we crossed the river Tanie Gawa by means of a well constructed bridge of boats, and observed a number of natives busily employed catching fish after various methods. Some were engaged dragging nets and driving the fish into elaborately constructed traps, in the making of which the Japanese are very expert, whilst others were engaged fishing with rod and fly after quite a civilized fashion.

At Haigo we took the train and returned about 80 miles to Yokohama, much pleased with our trip which occupied us about six days.

The next excursion was to Myenosta, a small hill station much resorted to by the inhabitants of Japan on account of its mineral waters. It is situated about 52 miles west of Yokohama, and not far from the famous sacred mountain of Japan called Fujiyama.

The first part of the journey was performed by carriage, the Tokaido or grand imperial high road of Japan having been followed as far as Yumeto, situated at the foot of the hills. From this point we walked up a distance of about 5 miles to Myenosta, the road and scenery very much resembling that between Rajpur to Mussoorie. Myenosta and its vicinity is essentially volcanic, there being many hot sulphur springs all over the neighbouring hills, which are highly appreciated for bathing purposes, the water being led into the bath houses by means of bamboo pipes.

The active nature of the volcanic action of this neighbourhood made itself felt on the night of our arrival by a sharp shock of earthquake, which rather alarmed some of the travellers.

The next day we visited the lake of Hakoni 9 miles distant, and situated in the middle of picturesque hills, on the top of one of which the Makado has constructed a new summer residence after the style of a French château.

In the neighbourhood of this palace extensive areas were being cleared of inferior kinds of jungle, and the planting of *Cryptomeria japonica* was in progress.

The cane brakes on the higher portions of the hills were also blazing on the occasion of our visit, with the object it was said of inducing a young growth of pasture to spring up, but apparently the grass of these hills forms very indifferent nutriment for cattle, and is absolutely fatal to sheep as already explained in the former part of this article.

The surplus water of this lake is carried through a hill of considerable breadth by means of a tunnel, and utilized for irrigating the rice fields of 17 villages situated far down the neighbouring valley. After enjoying the scenery at the south end of the lake for a while, we proceeded by boat to the upper end distant 9 miles, and then walked over the pass of Ajigoku, the meaning of which in Japanese is big hell. At this pass we found the whole hill side honey-combed by sulphur springs, many of which were boiling up on all sides and giving off clouds of vapour and sulphur fumes.

En route back to Myenosta we passed through a small patch of forest, where I observed a considerable number of box wood trees, most of which were, however, of small dimensions. The next morning I ascended a hill situated to the west of Myenosta, and obtained a magnificent view of Fujiyama, the snow-capped sacred mountain of Japan. This mountain is of volcanic origin, and it is said to have been extinct since 1707, when the last eruption apparently took place. It is about 15,000 feet elevation, and it may be seen during fine weather whilst 100 miles out to sea, towering above the clouds. Fujiyama is a great place of pilgrimage for the Japanese, but at the time of my visit the ascension could not be made on account of the deep snow, the path not being open till the end of June.

From Myenosta we returned to Yokohama *viâ* Enoshima, a small romantic island much resorted to by the inhabitants of Yokohama. At this place there is a fine cave 140 yards long and 10 yards high, much resembling Fingal's cave on the coast of Scotland, and which is much visited by pilgrims.

There are numerous Buddhist temples on the island, but the peculiarity of this place are the aquatic curios offered for sale, and which consist of coral and sea shells, and endless other articles manufactured from them. Here also may be obtained specimens of a curious glassy sponge, which the divers bring up from deep water, also immense crabs, some of which reach the astonishing dimensions of 16 feet between the extremities of the outstretched claws.

On the way back to Yokohama, distant about 18 miles, I visited a famous Buddha image called the Dai-Butsu.

This colossal statue is made of bronze and is 50 feet high, the length of the face being 6½ feet and mouth 3 feet wide.

Some idea may be formed of the degree of civilization to which the Japanese have attained by the fact, that a photographer has established his studio close to the Dai-Butsu, so that travellers can have themselves taken picturesquely distributed over various parts of Buddha's body or sitting on his thumbs.

In concluding this article it may interest intended visitors to know that the best seasons for visiting Japan are apparently from the middle of April to the end of May, and again from the middle of September to the end of October. During June, July and August the traveller's movements are said to be a good deal hampered by rain, and besides at that season fleas and mosquitoes are particularly troublesome, whereas during the time of my visit, *viz.*, from the middle of April to the middle of May, these pests were not noticeable.

As regards the cost of a visit to Japan, it may be stated that it is by no means a cheap country, actual travelling expenses at all events being about twice as high as in India. As regards other charges, they are as a rule also high, and in fact generally speaking the Yen or Dollar, equal to about 4 shillings, may be said to have about the same commercial value as the Rupee in India.

On the 15th of May I embarked on board the good ship "City of Sydney" for San Francisco, after a sojourn of about a month in Japan, very well satisfied with my visit to the "*land of the rising sun.*"

E. McA. M.

SUGGESTIONS FOR A MORE ECONOMICAL UTILIZATION OF COW-DUNG AND RAB IN THE BOMBAY PRESIDENCY.

READERS of the "Forester" are aware that a Commission was appointed several months ago to enquire into the alleged forest rights of inhabitants of certain villages in the Thána and neighbouring districts.

Of the matters to be investigated, not the least important one concerns the right to *Ráb*, and the means of providing either a substitute for it, or a sufficient supply without causing serious injury to the forests which are necessary to protect the hill-slopes.

Ráb may be defined as any forest produce of a vegetable nature used for manuring fields. It is used in the Konkan chiefly for manuring nurseries for rice-seedlings. For this purpose, loppings of trees, with or without cow-dung, are burnt: seed is sown in the ashes: and the seedlings which came up are ultimately planted out in the fields.

The present agitation in regard to this matter appears to be mainly owing to the fact that the forest originally given out for ráb material is no longer sufficient to produce a continuous and sufficient supply. This failure may be partly owing to the extension of cultivation, but it is also in a great measure owing to the exhaustion of the ráb forests, and the question naturally arises as to the possibility of employing substitutes for forest ráb, or of employing the materials used for manure more economically.

It seems to me that the method of preparing and burning the manure, which obtains in the Konkan, must lead to a vast amount of waste, and to a diminution of important chemical and physical activities in the soil. It also appears probable that these obstacles to a rational system of agriculture might be overcome by adopting more economical methods in preparing and applying the manure. Even when manure is not burnt, it is seldom, if ever, properly prepared or applied, and there can be little doubt that the manurial properties even of unburnt ráb and cow-dung might be considerably enhanced by a more judicious use of the materials available.

Let us consider what the effect of burning is. In the first place, all the moisture and organic matter of the manure are dissipated in the process. In this organic matter, it is chiefly the nitrogen that is important as nutriment, because it cannot be replaced except by means of artificial manures, or by precipitation from the atmosphere. The dissipation of nitrogen is, therefore, no doubt a serious loss to the crop. Large quantities of carbonic acid are also lost, but, as this gas is decomposed by the leaves, and is always contained in sufficient quantities in the air, its loss is certainly of much less importance to crops than that of nitrogen, viewing it purely in the light of plant-food. This admission does not, however, by any means imply that an additional source of carbonic acid is to be despised even as a means of nutriment; on the contrary, it is reasonable to suppose that an abundance of carbon would directly stimulate vegetation.

At the same time, the most useful function of this acid is undoubtedly its action as a solvent of other nutritive substances in the soil, and so highly does Wolff value it in this respect, that he considers no natural land could afford agricultural crops, a sufficiency of phosphates and carbonates without the presence of free carbonic acid in the soil.

In the second place, burning has the effect of diminishing the absorptive power of soils for nutritive substances, notably ammonia, phosphoric acid and potash, because soils containing a proper supply of organic matter are able to retain a much larger quantity of these substances than soils which are devoid of organic matter. There is, therefore, in the former case, less fear of nutriment being washed out or of its escaping in a volatile form.

A third objection to burning is that the physical properties of the soil are not improved, whereas, if manure be applied unburnt, the soil is improved physically by the organic matter, which in decomposing turns to a soft friable mould peculiarly suitable to the growth of plants, and which is considered of such importance, that the fertility of soils have often been gauged by the quantity of humus they contained.

I think I have said sufficient to convince the most obstinate cultivator, if he is open to conviction, that the burning of manure entails loss of nutriment, and that it diminishes in soils highly useful physical and chemical properties which certainly cannot be measured numerically, but which every practical farmer and forester know how to appreciate. All this is doubtless already known to the readers of this Journal, and I should not have dwelt at such length on the importance of not burning manure, had not a high authority on agriculture expressed his opinion that the methods employed by ráb cultivators in utilizing the materials at their command are the most economical and remunerative.

In all countries, agriculturists have been extremely tardy in deriving benefit from an increased knowledge of the nature of things, and Indian farmers are apparently no exception to this rule. But they are not all as unthinking as the average Thána ryot appears to be, or at all events he who lives in the forest tracts. A goodly number, perhaps a majority, do not burn their manure, and as a bright example of this genus, I may cite a friend of mine who is a large landholder in the ghát-tracts of this district. He tells me that formerly he used to burn his manure for rice-land, but that he has discontinued the practice because he finds that better returns are realized from *kucha* manure. Although the practice of using unburnt manure is common enough in this district, I must confess that I was agreeably surprised to learn that my friend had actually overcome this prejudice of custom, and changed to a system which indicates a decided advance, and leads one to hope that others may follow his example if they see the way clearly to benefiting themselves. It also strengthens my belief that the burning system is merely a bad habit. Fifty years ago, the forests in the neighbourhood of Bombay were considered of little or no value except for the teak and one or two other timber trees they contained, and people were free to take as much inferior wood for ráb burning as they liked. They have, therefore, become thoroughly habituated to their wasteful ways, and, although the forests are becoming exhausted, they are naturally unwilling to abandon what they consider to be a method essential to the making of their crops. In this prejudice, if it be merely a prejudice—and there is not a particle of evidence to show that it is anything else—they have a powerful supporter in the Director of Agriculture, who not only considers forest ráb ne-

cessary for their welfare—which may, or may not, be the case—but also that burning it is the best way of utilizing it as manure. For my own part, I can see no reason why—if kucha manure succeeds in a tract quite similar as regards climate and situation to another tract in which a different system prevails—the kucha system should not do equally well in both tracts. Nor does there appear to be any reason why grass should not be as efficacious as spray wherever a sufficient quantity of cow-dung is available.

Owing to the pernicious custom of allowing cattle to graze all day long in the forests, and to the apathy of cultivators in preparing, preserving and applying manure, there is a dearth of farm-yard manure in most ráb villages, but I believe that, if the simplest precautions were taken, a much greater quantity might be made available for the fields. For lands to which kucha manure is applied in this district, the manure is collected in pits and carried to the fields once a year. Great loss must be caused by allowing manure to lie so long unused, because nothing is done to prevent the escape of volatile or liquid ingredients by spreading layers of earth, lime, &c., from time to time over the manure, and by making pits impervious to liquids; nor is anything done to keep the manure moist and prevent too rapid decomposition. If these precautions were taken, and the manure put out on the land as soon as possible, the result would be a considerable improvement in the quantity and quality of the manure available for his crops. Experiments with pit manure, carried out at Pommeritz during the winter months, show, for instance, that in 12 weeks over 25 per cent. of dry matter were lost. It is not likely that cultivators will go to the trouble and expense of constructing suitable, impervious manure pits, nor that they will collect cattle urine to sprinkle over the manure, nor that they will ever simply water it; but it would give them no more trouble to put the manure on to their fields early in the season instead of late, although it would certainly be a less convenient season for the purpose, owing to the harvest operations being then in full swing. Rice fields are generally ploughed up immediately after the crop is taken off the ground in November—December, and all available manure at that season might be applied then, and ploughed under at the same time, instead of being allowed to run to waste in pits until the end of May. There is, I believe, a prejudice against ploughing in, but, of course, the more intimately the manure is mixed with the soil, the less probability is there of losing useful ingredients, and the more lasting it is in its effects as compared with manure simply spread over the surface although the immediate effects may be inferior. Where straw is not available for mixing with the cow-dung, grass (which is procurable in large quantities in all hill tracts) would probably be more useful than any other kind of forest ráb, as it absorbs moisture much more readily than

spray, and it is quite possible that, if the prejudice in favour of leaf ráb could be overcome, grass would prove a satisfactory substitute, for the chief use of ráb when mixed with cow-dung which is not to be burnt is to sop up the liquid part of the manure.

There can be no doubt that the system of sending cattle to graze all day long in the jungles is a serious obstacle to agricultural reform. It is much better to have a few home-fed animals than a large and badly-fed stock that spends all its days in the jungle. The custom is, however, an old established one, and, as such, is not likely to be abolished in a hurry. But, if no reform can be effected in this respect, some improvement might certainly be brought about in the stalls, or pens, in which cattle are kept, when they return from the jungles for the night. Sometimes litter is put down, but, in most cases, the cattle stand on the bare ground, and the liquid manure is all lost. If litter, consisting of grass, straw or spray, were put down, much of this—the most valuable—constituent of good manure would be saved. Properly constructed stalls made so as to completely prevent loss of liquid matter by percolation, are of course greatly to be desired; but are scarcely to be expected from the ordinary cultivator.

I am informed that it is customary in Thána to lop the same trees every year. If this is really the case, it may be safely predicted from what is known of the effects of ráb in Europe, that no forest can stand the drain, and that even if the area set apart for providing ráb were four times as great as that required, in the present state of the forests, to produce one year's supply, it would be very doubtful if the devastation of rábed areas could be asserted. Any measures, therefore, that appear likely to diminish the drain on the forests deserve the serious attention of all who are interested in the welfare of the race of ráb cultivators: the sooner the ryot learns to economize his materials, the longer will the ráb supply last, and the better will be his position to meet the day when the inevitable collapse must open his eyes to the real nature of things.

L. M. G.

THREE MONTHS' PRIVILEGE LEAVE TO NEW ZEALAND.

THANKS to the rivalries of the present excellent steam navigation companies the communications of the world are yearly improving, perhaps in no case more so than in that of Australasia. A three months' trip from India to New Zealand and back, which could not have been attempted a few years ago, can now be done with ease, giving the traveller time to take a rapid glance at the principal towns and main features of the country.

Starting from Dehra Dún on the 5th of July the following itinerary shows how my three months were spent :—

Left Dehra Dún,	July	5th.
Arrived Bombay,	„	8th.
Left „	„	10th, by P. O., S. S. "Mirzapore."
Arrived Colombo,	„	13th.
Left „	„	14th, by P. O., S. S. "Clyde."
Arrived King George's Sound,	„	25th.
Left „ „ „	„	26th.
Arrived Glenelg,	„	29th, went to Adelaide and back, by rail.
Left „	„	„
Arrived Melbourne,	„	31st.
Left „	August	3rd.
Arrived Sydney,	„	5th.
Left „	„	„ by Union Co. S. S. "Tarawera"
Arrived Auckland,	„	10th. Put up at the Star Hotel.
Went to Helensville,	„	11th, by rail to see Kauri pine forest.
Returned to Auckland,	„	12th, by rail.
Left Auckland and arrived Oxford,	„	13th, „
Left Oxford and arrived Ohinemutu,	„	14th, by coach, 33 miles.
Went to Rotomahana and back,	„	16th, 40 miles on horseback to look at the new volcano.
Left Ohinemutu, arrived Taupo	„	18th, by coach, 60 miles.
Left Taupo, arrived Tarawera,	„	19th, „ 50 „
Left Tarawera, arrived Napier,	„	20th, „ 50 „
Left Napier,	„	21st, by Union Co. S. S. "Manapouri."
Arrived Wellington,	„	22nd.
Left „	„	23rd.
Arrived Christchurch,	„	24th, left S. S. "Manapouri" at Lyttleton and went by rail, 9 miles, to Christchurch.
Christchurch to Dunedin,	„	25th, by rail.
Left Dunedin,	„	26th, by rail to Pt. Chalmers rejoining the "Manapouri."
Arrived at the Bluff,	„	27th.
Arrived Hobart,	„	30th.
Arrived Melbourne,	September	2nd.
Left „	„	7th, by P. O., S. S. "Sutlej."
Arrived Glenelg,	„	9th, went to Adelaide and back, by rail.
Left „	„	„
Arrived King George's Sound,	„	13th, spent the afternoon in Albany.
Left „ „ „	„	„
Arrived Colombo,	„	25th, spent the day on shore.
Left „	„	„
Arrived Bombay,	„	29th.
Arrived Poona,	„	30th.

Returned to Bombay,	October	1st.
Left Bombay,	„	2nd.
Arrived Dehra,	„	5th.

The actual cost of travelling, exclusive of the journey to and from Dehra, was as follows:—

	Rs.	A.	P.
Bombay to Sydney and back, by P. and O. steamers,	600	0	0

	£	s.	d.
Sydney to Auckland, by Union Co's. Steamer, ...	10	0	0
Auckland to Helensville and back, by rail, ...	0	10	0
Auckland to Oxford, by rail, ...	1	7	9
Oxford to Ohinemutu, by coach, ...	1	5	0
Ohinemutu to Rotomahana and back, horse and guide,	3	0	0
Ohinemutu to Napier, by coach, ...	4	5	0
Napier to Melbourne, by Steamer, ...	13	0	0
Lyttleton to Christchurch and Dunedin, by rail, ...	1	11	7
Glenelg to Adelaide and back by rail on two occasions,	0	8	8
Steam launch at Albany, ...	0	2	0
Total, ...	35	10	6

It will be seen from the above that a little over a fortnight was spent in and about New Zealand. The steamers of the Union S. S. Company leave Sydney weekly for New Zealand, *viâ* Auckland and East Coast ports, calling at Hobart every alternate trip on their way to Melbourne, and there is a similar service from Melbourne to New Zealand and Sydney.

People who are fond of town life and do not care for rough travelling had better not make this Australian trip. The towns are undoubtedly fine and in many respects improvements on English ones of the same size; yet there is an appearance of newness about them, which, though indicative of progress, is not pleasing to the ordinary traveller. The streets are not well kept as a rule, and most of the towns are badly lit, whilst the larrikin element of the population is somewhat too prominent. New Zealand contains numerous excellent harbors well distributed along its extended coast line of nearly 3,000 miles, and at these favorable spots little towns, containing usually a population of from 10,000 to 50,000, have sprung up; such are Auckland, Napier, Wellington, New Plymouth, Christchurch and Dunedin. But as I wish to describe some of the natural features of the country rather than its towns, I will pass over the latter, only remarking that as an example of colonial ambition all the towns are called "cities" and all the inns "hotels."

New Zealand is situated about 1,200 miles south-east of Australia, and is very nearly the antipodes of the British Isles, to which it is almost equal in area. It is in many parts very

mountainous, its most striking and important physical feature being an extensive longitudinal mountain range, which, interrupted by Cook Strait, runs through the whole length of the two larger islands from the South Cape to the East Cape. This range, consisting of up-heaved zones of stratified and massive rocks of different ages, constitutes the powerful backbone of the colony; it is most prominent in the Southern Island, where it forms the Southern Alps, many of whose heights are covered with perpetual snow, the loftiest peak being Mount Cook in the province of Canterbury, which rises to 12,349 feet above sea level. The limit of arboreal vegetation on these mountains varies between 4,000 and 4,500 feet.

Of the plains, those of Canterbury are the most extensive, whilst lakes are numerous, there being two distinct lake districts, *viz.*, that of the Hot Lakes in the North Island and that of the Cold Lakes in the South Island. The largest are Lake Taupo, with an area of 200 square miles, and lakes Te Anan and Wakatipu covering respectively 132 and 114 square miles.

The North Island is essentially volcanic, a fact of which the recent eruptions have more vividly than pleasantly reminded the colonists. There are some primary rocks, and the carboniferous deposit is strongly marked in the Bay of Islands. The South Island is mainly sedimentary, whilst its ranges are of slate and granite, with silurian sandstones and limestones.

The climate, as a whole, is agreeable, but varies considerably in different parts of the colony. The changes of weather and temperature are very sudden, and there is no uniformly wet or dry season in the year, although the greatest quantity of rain falls in the winter; January and February are the warmest months, June and July the coldest. The mean temperature is 55°, varying from a mean of 44·90° in the winter, to 65·4° in the summer. The average annual rainfall is about 45 inches, that of the South Island being much less than that of the North Island, *viz.*, 39 and 51 inches respectively.

The whole of the colony is noted for its breezes and frequent gales, of which there are generally over 100 in the course of the twelve months. As a protective measure, most homesteads have small belts of trees planted to the windward, mostly of the rapid-growing Californian pine (*P. insignis*), but sometimes of Australian Eucalypts and Acacias.

The first thing that strikes the new comer is the enormous influence which European settlers have had in modifying the ancient fauna and flora of the islands. It is not yet 120 years since Capt. Cook first landed on these shores. Since that time, however, the face of the country has changed more than Cook could have conceived possible in his wildest dreams of colonization and settlement. The formidable native population which swarmed along the shores, wherever he attempted a landing, has dwindled down to a comparatively insignificant remnant of

44,000, whilst the white population, which has displaced the natives, numbers about half a million. Except in the untravelled fastnesses of the country, there is no considerable area of agricultural or pastoral land that has not its fields of corn or its thousands of cattle and sheep. Stations, farm-steads, townships and cities have sprung up, where, in the beginning of the century, nothing was to be seen but endless tracks of tussock, fern, swamp-land or stretches of trackless bush.

The only indigenous mammalia are the native dog, the rat and two species of bat. None of the marsupial tribe peculiar to the Australian continent are to be found, whilst as regards reptiles New Zealand must have been blessed by St. Patrick, for there are no snakes and only a few harmless lizards. In years past the moa, that gigantic wingless bird of the ostrich tribe, must have been common, but its extinction took place before the islands were visited by Europeans. These birds still existed, however, in great numbers, when the first Maori colonists arrived, but they were most stupid and sluggish, and were destroyed wholesale by setting the grass or scrub on fire, when they would quietly allow themselves to be roasted alive. The natives killed in this way vast numbers, more than they could use or even could find, when the fire spread to great distances. Thus, we have here a remarkable instance of the complete extermination not of a tree or shrub, but of a bird, by jungle fires, which as we shall see further on have also considerably modified the flora.

The museum at Christchurch should be visited, as it contains one of the most complete collection of moas in the world.

Pigs were first introduced by Capt. Cook, and are now wild in most parts of the colony, so that pig-hunting with dogs has become one of the institutions of the country. Since then all kinds of domestic animals have been imported, and all have thriven well, amongst others, unfortunately, the rabbit, which has alas increased but too rapidly and is becoming a serious pest. New Zealand is better off for birds, there being 133 species peculiar to the colony, many of them water-fowl. Perhaps the most remarkable of all is the 'kea,' a species of parrot, which, since the introduction of sheep has developed a new instinct, giving up its vegetarianism, for the pleasure of killing these defenceless animals by the score and feasting on their kidney fat. This interesting but annoying instinct has induced some of the run-holders to put a price of 2*s*. 6*d*. on each kea's head.

Domestic birds have been introduced in large numbers, as also game birds, such as pheasants, partridges, quail and grouse, whilst sparrows and larks are now the commonest birds in the country.

With regard to the Flora, Dr. Hooker remarks as follows :—

"The rapidity with which European weeds, and especially the annuals of cultivated ground are being introduced into and disseminated throughout New Zealand is a matter of surprise to all observers, and

not only to professed naturalists. It is a point of very great significance in reference to all inquiries relating to their superior powers of propagating and establishing themselves which the plants and animals of some countries display, as contrasted with those of others; and when, as in the case of New Zealand, the result is the actual displacement and possible extinction of a portion of the native flora by the introduced, the fact may well arouse the interest of the most listless colonist."

Amongst such naturalized plants might be mentioned numerous *Cruciferæ*, *Caryophyllaceæ* and *Gramineæ;* the gorse, clovers and vetches; sweet-briar and the dog-rose; the elder; the daisy, groundsel and dandelion; the pimpernel; the plantain, and finally docks and nettles. At the time of my visit, the gorse was in full bloom, forming one of the most conspicuous objects in the landscape, and being particularly abundant in the Canterbury plains, where it is used almost universally for hedging purposes.

The indigenous flora is essentially an insular one of ancient origin, the Cryptogams far out-numbering the Phanerogams, and New Zealand may be regarded as the botanical region of ferns, which are represented by about 130 species, nearly one-third being peculiar to the colony, including many beautiful tree-ferns with trunks from 10 to 40 feet high. The common bracken (*Pteris aquilina*) covers hill-side after hill-side, and is thus very characteristic of New Zealand scenery. The rhizomes of the variety 'esculenta' were formerly roasted and eaten by the natives.

The Lycopods are the largest in the world, and the most closely allied to the fossil Lycopods of the coal period, of any existing plants. Indeed the flora vividly recalls some old geological period, and the analogy is rendered more real by the, in many places, sluggish streams, the numerous marshes and the great abundance of mosses and lichens which thrive so well in the moist temperate climate, covering every rock, stone, tree and fence. Open peaty valleys are also not uncommon, and on Stewart's Island in many instances the duramen of old trees is said to be converted into peat, whilst the alburnum is still discharging its functions. Still more striking is the fact of the dense lower leaves on the stem of *Raoulia goyeni* becoming changed into peat, whilst the upper ones are performing their usual duties.

There are about 1,000 flowering plants, of which two-thirds are peculiar to the islands, one-fifth are Australian, and one-tenth American plants. One of the most curious points about the flora is the paucity of leguminous plants. The *Leguminosæ* abound in Australia, especially the Acacias, but this order is less developed in New Zealand than in any other part of the world, and the genera are often most peculiar, *e. g.*, *Carmichælia*, usually leafless shrubs with small pods, the valves opening at the tip only: this is the native broom of the settlers.

The genus *Pittosporum*, two or three species of which occur in the sub-tropical forests along the base of the Himalayas, is here represented by a dozen species. Amongst other genera or species common to the two localities mentioned are—

Dodonæa viscosa, *Coriaria*, *Rubus*, *Panax*, *Loranthus*, *Myrsine*, *Olea*, *Cuscuta*, *Veronica*, *Vitex*, *Tetranthera*.

The *Coriaria ruscifolia* is very similar in appearance to the common Indian shrub *C. nepalensis*. The genus *Rubus* is represented by a single species, *R. australis*, a lofty climber, armed with scattered prickles, and called by the settlers the 'bush lawyer,' because they invariably suffer from too close an acquaintance with it.

The genus *Panax* is interesting from the fact that in many species the leaves are di- or tri-morphic. Mr. Kirk thus describes *P. crassifolium* in the Transactions of the New Zealand Institute:—

"A small dicœcious tree 20—35 feet high; leaves di- or tri-morphic; on young plants up to 15 feet high, simple, linear, rigid, coriaceous, 12—30 inches long, spreading or drooping so that the under surface forms an acute angle with the stem, remotely or sinuately toothed, narrowed into a short, stout petiole, purplish below, brownish-green above, with more or less irregular pale blotches; abruptly passing into tri-foliolate leaves, of which the petioles are about 3 inches, and leaflets 3—6 inches, ultimately succeeded by the mature unifoliolate state, the leaf being lanceolate, oblanceolate or obovate and 3—7 inches long. The benefit which the plant derives from these changes does not appear to be known or even to have been discussed."

New Zealand possesses three genera of *Loranthaceæ* comprising nine or ten species, and Mr. Kirk gives an interesting instance of double parasitism in the case of *Tupeia antarctica* growing on *Loranthus decussatus*, which derived its nourishment from a beech tree *(Fagus solandri)*. The portions of the supporting branch of the *Loranthus* beyond the point of attachment of the *Tupeia* were usually dead or dying, showing that the latter had absorbed a large quantity of the juices necessary for the full supply of the foster parasite.

The order *Myrsineæ* represented by the genus *Myrsine*, advances much farther south in these islands than in any other longitude. There are three species of *Olea* all with apetalous flowers. The genus *Veronica* forms a more conspicuous feature of the vegetation here than in any other country, both from the number, beauty and ubiquity of the species, from so many forming large bushes and from their remarkable forms. Hooker enumerates no less than 40 species.

The order *Verbenaceæ* is represented by four species, the most important being the puriri *(Vitex littoralis)*, its wood being in great demand, being extremely hard and almost indestructible under water. There is only a single *Tetranthera*. *T. calicaris*,

and this is confined to the North Island. The tropical orders *Meliaceæ* and *Anacardiaceæ* have also only a species apiece, *Dysoxylum spectabile* and *Corynocarpus lævigata*.

There are scarcely 20 species of *Myrtaceæ*, and the large and important genus *Eucalyptus*, so characteristic of Australia, is entirely absent. The paucity of species is, however, compensated for by the extreme abundance of one of them, *viz.*, *Leptospermum scoparium*, the tea-tree of the settlers, so called because the leaves have been used as tea in Tasmania and Australia; in fact, the manuka scrub, if we adopt the Maori name, is typical of New Zealand scenery. This species is remarkably prolific, seeding at a very early age, and occurring either as a small bush on poor soils and on low-lying badly-drained ground, or as a small tree 10-40 feet high on hill-sides and on good well-drained soils; in fact, the condition of the manuka scrub often guides the settler as to the quality of the land he is about to take up. Another prominent myrtaceous plant is the rata, which acts the part of the Indian peepul, killing the tree it embraces.

There are two species of fuchsia, which genus is found nowhere else in the old world. They appear often to form a natural protective belt against fire around forests of rimu and other inflammable conifers, and the Conservator thinks of utilizing this property in the formation of permanent fire-lines.

The large order *Rubiaceæ*, which in the north temperate zone contains only herbaceous species, is here represented by numerous shrubby forms belonging to the genus *Coprosma*, which is especially characteristic of New Zealand; all the species are diœcious with very small flowers and exserted anthers.

Shrubby *Compositæ* are pretty common, the genus *Olearia* being largely developed both here and in Australia. *Raoulia eximia* is a most singular plant, forming on the mountains large woolly balls 2 feet high, the whole plant being enveloped in the soft velvety, white tomentum. These plants are called 'vegetable sheep,' and an old settler delights to take in a new arrival by pointing to a lot of these plants on a hill-side and asking the uninitiated one to "fetch down them ere flock of sheep."

Pisonia umbellifera, a shrub belonging to the *Nyctagineæ*, is remarkable for its viscid pericarps, the viscid substance acting it is said like bird-lime, so that small birds, such as Silver-eyes (*Zosterops*), sometimes get glued on by their wings.

Most of the *Coniferæ* are important forest trees, and will be mentioned later on; the species of *Phyllocladus*, or celery-leaved pines, are of special interest to the botanist from their singular foliaceous appendages often resembling ferns; thus *P. trichomanoides*, a handsome tree 70 feet high, derives its specific name from the resemblance of its leaves to that of species of *Trichomanes*.

There are several characteristic liliaceous plants. *Cordyline* (or *Dracæna*) the palm-lily, is a conspicuous feature in nearly

every New Zealand scene; it is the well-known cabbage palm of the settlers. The large grass-like Astelias are common epiphytes on the branches of forest trees, and without them the 'ensemble' of many a New Zealand forest would be incomplete. The New Zealand flax (*Phormium tenax*) belongs to a genus found only, elsewhere, in Norfolk Island. The extraction of the fibre, which is largely used for rope-making, has given rise to an important industry, and the annual value of the exports of phormium, as the fibre is called in commerce, amounts to about £25,000.

There is only one indigenous palm, *Areca sapida*, called Nikau (worthless) by the Maoris, because when they first saw it they mistook it for a common tree of their native land, probably *A. Baueri*, whose young inflorescence they were fond of eating, and bitter was their disappointment when they found nothing edible in the New Zealand species.

To sum up; the plants which help more than any others to give a peculiar character to New Zealand scenery in the open country are the bracken, covering mile after mile of undulating hills, the cabbage palm scattered here and there amongst the ferns, being particularly common near streams, and the New Zealand flax, which is most abundant in marshes, along the banks of rivers and in damp ravines.

The forests are different from any other forests in the world, rivalling those of Burma in their density, but containing scarcely a living thing, the more or less complete absence of birds and animals being almost appalling to one accustomed to an Indian jungle. There are over 100 indigenous forest trees, the more important being the kauri pine (*Dammara australis*), the totara (*Podocarpus Totara*), the matai or black pine (*P. spicata*), the kahikatea or white pine (*P. dacrydioides*), the rimu or red pine (*D. cupressinum*), and the tanekaha (*Phyllocladus trichomanoides*) all conifers; the puriri (*Vitex littoralis*), hinau (*Elæocarpus dentatus*), rata (*Metrosideros sp.*), rewarewa (*Knightia excelsa*), and four species of beech.

The totara is the most durable of all, and is greatly valued for piles, as it resists the ravages of the 'teredo navalis' better than other timbers. The rimu is a beautiful wood, very suitable for furniture, but rather difficult to work, which makes it expensive. The puriri is extensively used for posts and rails, and of late for railway sleepers. But what first drew to New Zealand the notice of European traders was the supply of excellent spars to be got from the kauri forests of Auckland. Even now no New Zealand wood is of such general use for all kinds of work from shipbuilding to cabinet-making. For the last named purpose a peculiar mottled variety, capable of taking a high polish, is in particular request, a single tree of this variety having realized as much as £500 for the 22,000 feet of timber it contained. The southern limit of this pine is latitude 37° 30′, so that to Auckland belongs the whole supply. Unfortunately the exträ-

vagant rate at which the kauri forests are being despoiled of their timber, points to the probability of this noble tree becoming as extinct as the moa, unless Government intervenes effectively, which they at last seem inclined to do. At some former period the kauri must have covered enormous tracts of country now denuded of all vegetation except poor fern and manuka scrub. Those tracks, notorious for their sterility, are now indicated by large deposits of a fine resin resembling amber, the export of which, valued at £340,000 annually, forms no inconsiderable part of Auckland's commerce. The supply is not likely to fail for sometime, as it is now found that the gum lies in many cases at a considerable depth, and is indeed mingled with the strata of tertiary coal which abounds in the province. The largest kauri tree is said to be that in the valley of the Thames; it measures 46 feet in girth, 130 feet in height, and its lowest branch is 60 feet from the ground.

The area under forest is more than one-fourth of the total area of the colony, but the forest lands are irregularly distributed, the greatest bulk being found in Auckland, Wellington and Westland, whilst a large portion of the hot-lake district, and the Canterbury plains are treeless. The area of forest reserves in 1884 was 594,051 acres, and of plantations 27,075 acres, of which 25,000 acres were in Canterbury. There are about 200 saw-mills in the colony, employing about 5,000 hands, and turning out more than 200 million superficial feet of sawn timber annually. A very large proportion of forests in the North Island is still in the hands of the Maoris. In Auckland the most important tree is kauri; in Southland and Westland, rimu; in Hawke's Bay, totara, and in Taranaki, tawa.

The forests have hitherto been worked on no principle whatever, but simply as mines, and the reckless waste and destruction which has thus been caused is simply appalling. As a consequence, it is calculated that with the present system, or rather want of system, the kauri will be practically worked out within 15 years, and that the supply of totara in the Hawke's Bay district will come to an end even before that period has expired. The forest practically disappears over the areas worked by the saw-mills, as no precaution is taken to preserve it, after all the valuable timber has been extracted; indeed it is usually burnt, and the fire, fed by the débris from the recent fellings, and by the inflammable nature of most of the conifers, generally makes a clean sweep of the entire arboreal vegetation. Mr. Kirk states that in Southland the total area of forest land granted for saw-mill leases during the three years ending the 30th September, 1885, was 5,901 acres, so that, including mills on private land, over 2,000 acres of forest are denuded yearly in this province alone. The forests are often leased at very low rates, and in Canterbury good timber land has been sold for the inadequate sum of £2 per acre.

As an example of the wanton destruction which is going on, Mr. Kirk speaking of the forests on the banks of Lake Wakatipu says—"Licenses to cut fire-wood amongst the small shrubby growth have been granted and acted upon without the slightest supervision having been exercised.

"As soon as the firewood has been removed, a lighted match is applied to the mass of tops and spray not deemed of sufficient value to defray the cost of removal; the mountain-slope is quickly lighted up with a bright blaze, and any renewal of the natural growth is rendered next to impossible; charred stems of palm-lilies (*Cordyline*), rata, beech and other small trees are all that remain to tell of the luxuriant vegetation which once clothed the slopes. The ashes, however, facilitate a luxuriant growth of groundsel, thistles, piripiri, and other weeds, diversified only by scattered bushes of bush-lawyer, and similar unwelcome growths. The transformation is now complete, the grace and beauty of nature are replaced by rugged untidiness, and one of the most attractive features of the scene destroyed for ever."

In the kauri forests large quantities of timber are yearly destroyed by fires caused by kauri-gum diggers. I myself saw two or three examples of such fires, and although accustomed to fires in Indian jungles, I had never seen anything approaching the devastation caused in these instances.

No trees seemed to escape, but all to be killed outright from the sapling to the giant over 20 feet in girth. This excessive virulence is doubtless due to the quantity of resin in the kauri itself and in the ground at its roots, which makes it very difficult to put out a fire once thoroughly kindled. There can be no doubt but that the present condition of the vast areas covered with bracken and manuka scrub is due to fires, the fern being able to hold its own, and to spread on account of its rhizomes, and the manuka from the protection its seed obtains, enclosed within the hard stony pericarp; indeed, settlers told me that manuka seedlings come up like grass after a bush fire.

The yield per acre in most of the New Zealand forests is very large; thus, in Westland it is estimated at 40,000 superficial feet for red and white pine, whilst near Lake Brunner several acres gave over 80,000 feet. Owing to the kauri occurring in patches, in mixed forests, the average quantity per acre over large areas is probably only 15,000 superficial feet, although in some parts it would run as high as 120,000.

Mr. Kirk's remarks in his report on the forests concerning the timber industry in Auckland are sufficiently interesting to justify their being quoted 'in extenso.' He says—The total value of timber exported from Auckland is returned at £135,952, or more than five times as much as all the rest of the colony put together.

"The large dimensions of the kauri increase the cost of bringing timber to the mill; and in many cases the difficulty is further increased by the broken character of the forest, which renders the con-

struction of tramways almost impossible, so that, speaking in general terms, tramways, invariably used in the south, are rare in the north. The mill is usually erected on the banks of a creek or navigable river, so that the logs may be floated down. If the trees are growing on the banks of a stream, they are felled, cross-cut into suitable lengths, and the logs rolled into the water. When growing at some distance from water it is necessary to construct "rolling roads;" these are broad tracks from 30 feet to 40 feet wide, in which every advantage is taken of the natural incline of the surface, and from which all trees have to be removed, the stumps cut level with the surface, inequalities roughly levelled, and large holes filled up. The logs are forced along these roads by "timber-jacks" until they reach the water. In this way the logs are moved with great ease; the bushmen exhibit a great amount of dexterity in their work, and move the largest logs with a speed which surprises any one who witnesses it for the first time. In no other part of the colony is the jack used for moving timber to any extent—in fact, its use is but rarely required on account of the smaller dimensions of the logs—but I never saw it used with equal dexterity, or with a greater amount of intelligence, in England. If the creek contains water of sufficient depth to float the logs, they are simply rafted to the booms at the mill, to be converted as fast as required. It often occurs that the creeks are too shallow to float the logs, so that they must either be conveyed by a tramway to the mill or to deep water, or must wait until a fresh occurs in the stream, unless driven by water stored at high levels by means of dams. The construction of these dams often involves a considerable amount of heavy work and a serious outlay; in some cases side dams are necessary to collect additional water in the small tributary creeks in order to procure a sufficient volume."

The best way for the traveller to see a kauri pine forest, is for him to go by rail from Auckland to Helensville, which is reached in rather less than three hours, and there to hire a horse and ride seven miles to the Bridge Hotel, Kankapakapa, the owners of which are two brothers, who are also employed in working out kauri from an adjacent forest. They were rough but kind, and putting me on a wiry mount showed me all over their forests, and a finer sight a forester need never wish to see. The tall kauri pine with its branches and trunk covered with mosses and lichens gave a temperate, not to say arctic, appearance to the upper stage of the forest, whilst below, the tree-ferns and the areca palm reminded one of the tropics. A few ordinary pines were occasionally intermixed, especially kahikatea and rimu, whilst rewarewa and tawa also occurred sparingly. The kauri appears to be a slow-growing tree, and on the section of the trunk of one recently felled, which had a diameter of 3 feet 6 inches, including 3 inches of sapwood, I counted no less than 256 rings. The two brothers showed me a rough but most effective tramway made of kauri sleepers which would last about 10 years. The tram-cars were very strongly built, with wheels 6 inches wide running on the sleepers without a rail or groove,

and the axle of the wheels was so arranged, that it could shift up and down following the unevenness of the road, a key right through having been found to be a mistake. Logs from 70 to 80 feet long and from 20 to 30 tons in weight could be carried on a couple of trams, the logs resting on iron bolsters, and being kept in position by a chain and an union screw. Full particulars concerning the construction of this tramway would, I have no doubt, be willing supplied by Messrs. Jagger and Parker, Timber Merchants, Auckland, New Zealand.

Drifting sands similar to the dunes of Gascony are common along parts of the coast, as the Waikato Heads and the Kaipari sand-hills, and although Mr. Kirk made suggestions as long ago as 1873, for arresting the process of destruction going on in so many localities, by planting operations, it is believed that little or nothing has been done in the matter up to date. The magnitude of the evil to be remedied is admitted by all who have paid the slightest attention to the subject. In several localities the natives are compelled, year by year, to abandon their cultivation as the sand-wave advances, and settlers are helpless witnesses of the invasion of their paddocks by the same cause. Fences, large trees and patches of bush, have been overwhelmed within the memory of settlers of comparatively recent standing.

It is pleasing to note, however, that Government are at last awakening to the importance of an industry, whose exports amount to half a million yearly including gum, in addition to the enormous local consumption of timber. In September 1885 an Act was passed to provide for the reservation of State Forests in New Zealand and for the control and management thereof. This Act empowers the Governor in Council to set apart land for State Forests and to make regulations for such forests on the following subjects amongst others :—(1), Duties of forest officers and subordinates ; (2), Prevention of destruction of growing timber ; (3), Terms of forest licenses ; (4), Protection of forests against fire ; (5), Construction and use of railways, tramways and other roads in the forest. The Governor in Council may impose reasonable penalties not exceeding £50 for any one offence, the penalty imposed being recoverable by a civil suit. Clause 26 of the Act is rather instructive, as, doubtless owing to the difficulty in proving forest offences, the burden of proof is thrown on the accused. It reads as follows :—

"Any person found within any State forest, or on any road in its vicinity, and having in his possession any tree or part of a tree, who, on being thereunto required by any Conservator of forests or other officer under this Act, or by any person having a right to cut wood on any such forest or part thereof, or by any one acting on behalf of such person, refuses to give a satisfactory account of the manner in which he became possessed of any such tree or part of a tree may be taken by the party interrogating him before any Justice of the Peace; and if such person does not satisfy the Justice that he came lawfully

by the said tree or part of a tree, he shall on conviction by such Justice forfeit and pay over and above the value of such tree or part of a tree so found any sum not exceeding £5."

A similar maximum of fine in the following case seems to be very inadequate :—

"Any person marking any timber with any brand not belonging to him, or branding any timber belonging to any other person with any brand other than the brand of the owner thereof, shall be guilty of an offence, and shall be liable to a penalty not exceeding £5 for every such offence."

It is doubtful whether any person would be deterred from committing such an offence, by this ridiculously low penalty, as a single log would often be worth more than the maximum fine. In the Indian Act such an offence is punishable with two years imprisonment as well as fine. The punishments in the New Zealand Act are all remarkably light, imprisonment not being mentioned, and perhaps the only punishment which may be regarded as heavy is the poundage fee charged on cattle which have trespassed in a forest reserve. The fee is 5*s.* per head for any kind of animal, there being no graduated scale as in our Indian Act.

The first result of the Act was the appointment of Mr. Kirk as Chief Conservator in December 1885, and reports on the present state of the forests, and on bark and secondary forest produce have been submitted by him to the Assembly, whilst he is engaged in preparing a popular descriptive work on the timber-trees of the colony, under the title of "The Forest Flora of New Zealand."

It is proposed to organise a combined School of Forestry, Pomology, and Agriculture at Whangarei; Pomology being included, as fruit-culture is fast becoming one of the most important industries of the colony, whilst the fruit trees are particularly liable to disease. The organisation proposed by Mr. Kirk is as follows :—

"1. THE STAFF.—TEACHING. *A General Manager*, who should have sole charge of the institution, subject in all respects to the approval of the Commissioner of Forests, and should be held responsible for the maintenance of discipline and the efficient working of the school. He must be thoroughly acquainted with the theory and practice of agriculture, and be able to lecture on the subject. He should have had experience in the management of a teaching-staff and in the control of students.

"2. *Biological Lecturer.*—The biological lecturer must have a theoretical and practical knowledge of botany and zoology, with a detailed knowledge of ordinary forest- and fruit-trees, agricultural plants, especially of grasses and forage-plants, both Native and introduced. It would be an additional advantage for him to possess a knowledge of the diseases of plants, whether constitutional or parasitic, more especially those of a fungoid character, and with the chief external and internal parasites of farm-animals. He would be re-

quired to take charge of the biological laboratory and museum, also of a portion of the experimental grounds, and to carry out such experiments as may from time to time be deemed advisable.

"3. *The Chemical Lecturer* must be well acquainted with inorganic and organic chemistry, more especially as applied to the products of the forest, the orchard, and the farm. He will be required to lecture on chemistry and physics; to take charge of the chemical laboratory, and carry out such inquiries and experiments as may be required.

"4. *The Lecturer on Forestry and Pomology* must be acquainted with the theory and practice of these branches, and competent to give directions to the forester. He should take charge of the plantations and orchard, also the larger portion of the nurseries and experimental grounds.

"5. *The Mathematical Lecturer* will be required to teach geometry and trigonometry as applied to land-surveying; levelling, mechanics, and hydrostatics; also book-keeping for the forest, farm, and orchard. The practice of surveying and levelling must be taught in the field.

"*A Porter*, whose business it should be to keep the lecture-hall, class-rooms, laboratories, library, lecturer's room, and offices in proper order, and to light fires, lamps, &c.

"THE STAFF—THE PLANTATION, ORCHARD, AND FARM.—*A Gardener and Forester* who must also be well acquainted with fruit-growing. He must be capable of carrying out experiments and instructing students in the plantations and orchards.

"*A Dairyman* to take charge of the dairy and the general supervision of the stock.

"When the School is well under way it might be found practicable to give a limited amount of instruction in carpentry and smith's work as applied to farm and forest purposes

"ROUGH STATEMENT OF ACCOMMODATION REQUIRED IN THE SCHOOL-BUILDINGS, HOUSES FOR LECTURERS, &c.—Residence for Manager (eight rooms); day-rooms and dormitories for resident students, dining-hall for students, kitchen, lecture-hall, two class-rooms, biological laboratory and museum, chemical laboratory, reading-room and library, manager's office, lecturer's room, porter's room, &c.; two houses for lecturers (six rooms), two houses for lecturers (five rooms), three cottages—for forester, farm-manager, and dairyman (one six rooms, two five rooms), garden-shed, tool-house, and packing-room. I believe the above might be erected for £1,000; but it is desirable that a professional estimate should be obtained.

"FARM-BUILDINGS, &c.—Stabling for horses, milking-shed, cattle-yards, &c., piggeries, implement shed, dairy and cheese-room, superintendent's office and seed-room, granary

"In compliance with the suggestion of the Commissioner of State Forests, the salaries for lecturers on forestry and on mathematics are omitted in the following estimate for the first year, their work being discharged by the biological and chemical lecturers respectively; Manager, with house and profit on board of students, £500; biological lecturer, with house, to lecture also on forestry and fruit-culture, £300; chemical lecturer, with house, to lecture also on mathematics, £250; forester and gardener, with house, £125; dairyman, £100; porter, £80; total, £1,355. The salaries of the lecturer are too low

for properly-qualified men; but this point will be referred to elsewhere. It is assumed that a superintendent of farm-labour may be dispensed with for the first year."

The following remarks show that it is not intended to pamper the student by too much attention, thus rendering him discontended with his future rough life :—

"The annual cost of maintenance will be greatly increased if it be determined to provide the students with any great amount of luxury. In my opinion each student should be required to keep his bed-room and study in proper order, to clean his own boots, to wait at table in due course, and discharge other duties of a kindred nature. Discipline of this kind would involve no real hardship and would foster a healthy spirit of self-help. Settlers of restricted means entertain the idea that the amount of attention sometimes paid to students at agricultural schools tends to render them dissatisfied with their homes, and unfits them for the plain homeliness of a settler's life. Any course tending to produce this feeling should be avoided as far as possible. If a large staff of waiters and attendants has to be maintained the fees must of necessity be high, which would prevent struggling settlers from taking advantage of the facilities afforded by the school. If, on the other hand, the students are required to wait upon themselves, as the majority would have to do in their own homes, the fees need not be higher than would be sufficient to cover the cost of board, the student's labour being considered to some extent an equivalent for the cost of teaching and the use of apparatus."

It is much to be regretted that with all these well-meaning efforts to preserve their forests, the colonists have no one who really understands what forestry is, or how extensive forest areas should be managed. The only idea, which is essentially that of a nurseryman, appears to be to cut down so many acres of indigenous forest every year, and to replant the worked out area with introduced species, such as eucalypts and wattles. It also seems to be thought that any one can lecture on forestry, thus £300 a year is to be provided for a biological lecturer who is also to lecture on forestry and fruit-culture, but where such a highly-qualified gentleman is to be obtained for the pay, is not apparent. It is not clear how forestry can be started on a sound basis, unless the colony first of all obtains the services of some one who has been trained in the principles of forestry as taught on the continent of Europe, or at the newly-organized Forest School at Cooper's Hill, and it would be a step in the right direction if two or three young colonists were given a training by the State at Cooper's Hill, so that in this way the services of trained foresters thoroughly acquainted with the colony would be obtained.

TAU-THA.

A WORKING SCHEME.

AFTER perusing with interest, in the "Forester" for July last, the opening remarks of the review of the Madras Forest Admi-

nistration Report for 1884-85, I was checked at the third page by an account of a working scheme for the Coonoor Peak "Old Forest Plantation," on the Nilgiris, which is there mentioned and quoted from.

In the first place it seems to be quite a mistake to attribute the scheme to Mr. Gass. For it is stated in the report (Appendix A., Northern Division) that although a scheme *was* prepared in 1883 by Mr. Gass, it was judged expedient the next year to alter it, and from what follows that officer does not appear to be responsible in any way for the present scheme.

In Chapter III., under "Working Plans," the operations of the year in this plantation are mentioned, and Appendix A. is referred to as giving "the revised working scheme." Appendix A. must, therefore, be taken as containing the provisions for the management of the plantation which the officer in charge will have to depend upon for his guidance.

It appears that a final sub-division into blocks and compartments was made in 1884, and that the treatment was to be "high forest" from that moment. It is considered probable that a 60 years' rotation will suffice, to be divided into six periods ('five' is presumably a mere slip) of 10 years each; at any rate there is to be a "rotation of 10 years thinnings." After this comes only the description of blocks and compartments before the "plan of working for coppice." And here it may be observed that, as is remarked in the review, no clear account of the standing crop, the fundamental point in a working scheme, is given. Still it need not have been assumed in the review that it is composed of *Acacia Melanoxylon*, for from the mention of blue-gum when considering the high forest rotation it may be inferred that the stock consists fundamentally of that tree, and besides only two compartments (area 10·4 acres) are mentioned as containing acacia.

To return. Beyond arranging for 10 year periods and a probable 60 years' rotation, no provision for working has so far been made. Consequently the 'plan of working for coppice' must be part of the scheme for which high forest has been taken as the method of treatment.

Now come the 'general prescriptions' (for coppice rotation), the results of which require consideration. In the first rotation 400 trees per acre are to be left as standards. If 600 so much the better. Also shelter belts at least three trees thick along the edges of compartments and roads. Now it is stated in Mr. Hutchins' report on the measurement of the growth of Australian trees on the Nilgiris that the plantation, or at least 200 acres of it, was originally planted 9′ × 9′, and consequently contained 537 trees per acre (if there were no failures). Suppose, however, 450 trees per acre were left (to leave 600 being impossible), the result is a coppice-felling which is really a thinning out of one-sixth of a uniform and perfectly distributed stock. That is not the common idea of a coppice-felling.

But there are to be shelter belts left. At the lowest computation, taking an average compartment of 5 acres and supposing it to be nearly square, the more belt round the edge, since three trees 9 feet apart will take up a breadth of 9 yards, will occupy about 1¼ acre, or 22 per cent. out of the five. If this is counted in and the trees it contains as part of the 2,250 (at 450 per acre) to be left, it will bring the thinning up to about 20 per cent., but the plantation at the end of the first period will be covered by a network of bands 18 yards broad occupying 22 per cent. of its area (in reality more, on account of roads and the irregular shape of the compartments) of trees standing 9′ × 9′ untouched since they were planted and of an age equal to one-third of the rotation considered likely to suit for high forest.

In the second rotation the standards are to be reduced to 300 and gradually to 40 or 60 by the end of the sixth period, but whether the belt is to be touched or to what extent is not stated. No doubt there will be a fully stocked high forest of big timber at the end, but there evidently exists a fully stocked high forest (though not of big timber) already, and so there will be continuously between this and the end of the rotation.

What then is the meaning of these "coppice rotations" and a belt which should protect coppice growing under a fully stocked high forest containing only 20 per cent. trees less than the belt itself? Fortunately it is mentioned that the scheme is liable to revision at any time, the contemplated reason which may necessitate a revision being a possible largely increased demand for fuel, in which case a return to simple coppice is felt to be best. But why was the method of treatment ever changed? If demand for fuel largely increases the reasons for change will be financial: but in deciding on high forest the same point, with respect to timber, is not considered. In fact no reason for adopting the method is given at all, but the argument passes abruptly from the necessity of changing the original plan on account of damage by storms, for which too a good remedy is proposed, *viz.*, rearrangement of the compartments, to the un-motived 'determination' to change to high forest.

As to the concluding para. of the Appendix its meaning is hopelessly obscure. Which are the compartments under reproduction every third and sixth years? What is the nature of the reproduction? Is the coppice to be thinned or the standards? And how are blanks in a coppice growing under thick and fully stocked high forest to be recognized?

It is possible that this scheme represents a practical management to the person who compiled it, but a working scheme ought to be reasonably intelligible at least in its broader provisions to an outsider. It may be a fair attempt to provide for the management of an interesting plantation, and it is hoped that some explanation of it will be given in the "Forester," but it is a pity the Conservator did not consider and revise it before giving it his sanction by printing it in the annual report.

P. & P.

NURSERIES FOR RUBBER, (*FICUS ELASTICA.*)

SEED-BEDS should be prepared where the soil is neither too moist nor too dry. The ground should be well hoed to the depth of 2 feet, and the earth exposed to the sun for a day or two, and then hoed again. When the soil is soft, raised beds should be prepared a good foot above the ordinary level. The beds at the Charduar plantation in Darrang were, if rightly remembered, 40 feet by 3 feet.

Charcoal should then be powdered finely and mixed with the upper portion of the soil. The whole of the upper surface of the bed should be fenced in by reeds, sufficiently high to keep the earth from falling away and carrying seed with it, when being watered, &c.

The next step is to build a shade over the beds. The shade should be sloping, being 6½ feet high on one side and 4½ feet on the other, the higher side facing the north, for the length of the beds should run east and west. This shade should be light and is easily constructed, the posts being first fixed with a few purlins, and then light frames of thatching grass tied firmly on to them. Great care must be taken that this roof does not leak, and that the beds are far enough apart to ensure the drip from neighbouring roofs against falling into them.

It is now time to sow the seed. This should never be done with the whole fruit, which should be broken between the hands and pressed frequently through a fine sieve. It should then be thrown broadcast over the prepared beds, with an extremely light covering of earth. About five seers of seed (not broken) are necessary for beds 40 feet by 3 feet. The best time to sow is early in April, though the seed will germinate no matter when sown. It was observed that seedlings were stronger and germination more profuse from April's sowings.

The beds should then be lightly watered for the first few days, but not afterwards till germination, unless it is exceptionally dry. After germination, light watering is necessary, which is increased as the seedlings grow stronger.

When the seedlings begin to look strong, the shades should be removed, but very gradually indeed, or the young seedlings will be scorched. The shades should be moveable, so that they may be replaced during the hottest portion of the day.

On attaining a height of two inches, the seedlings are fit for pricking out into beds, which should be specially prepared for them, but not raised. These beds are 2 feet wide, and seedlings are pricked out 18 inches apart in a double row, at the Charduar plantation.

The transplanting beds must be kept very clear of jungle till the seedlings are strong enough to keep it down. They require no other care, except that in planting them out again on their final resting places, the roots should not be injured. Planting

out on mounds is advisable; just when the rains commence or are about to close being the best time.

Before germination of seed and immediately after it, moss used to grow on the seed-beds and do grave damage at Charduar, and this was only removed by deep hoeing in the first instance. Innumerable grubs also did immense harm subsequent to germination, and here the removal of shades and watering with tobacco mixture, &c., was beneficial.

JUNGLI.

ABYSSINIAN TUBE WELLS IN TARAI FORESTS.

THE forests of Eastern Kumaon outside the hills are noted for their extreme unhealthiness, attributable partly to the impurity of the surface water, which in the absence of wells is used for drinking purposes. Although one or two masonry wells have been sunk in this part of the Division, the work is rendered costly and difficult on account of the absence of skilled labour of any description.

It was, therefore, proposed last year to experiment with one of Norton's tube wells, with a view of both speedily and cheaply obtaining pure water free from surface impurities.

The actual cost of 30 feet of tubing and a pillar pump necessary for *each* well amounted to £3 14*s.*, but the necessary tools for sinking an indefinite number of wells were also procurd at an outlay of £13 9*s.*, freight, &c., to India came to £2 2*s.*, and there were the usual fail and agent's charges. It is probable that the articles now required, *viz.*, piping and pillar pumps, can be cheaply procured from the local workshops, and that Rs. 50 or Rs. 60 would cover the cost of each well sunk to a depth not greater than 30 or 40 feet.

Employing four coolies in the experimental sinking, water was reached at 20 feet in a bed of very fine sand. This speedily choked up both tubes and pump, and all the tubes had to be withdrawn. After substituting a gauze covered borer for the one with large perforations the tubes were again sunk to 30 feet, but here the water-bearing soil had been passed. The tubes were then raised 5 feet, and a continuous flow of good water followed the application of the pump. All that remained was to embed the base of the pump in masonry.

In spite of various contretemps due to inexperience, the work was completed in one day; in other circumstances, a few hours should be sufficient.

The system is recommended to Forest officers stationed in districts where water is scarce or bad, and where the subsoil is free from large boulders or rock.

If water when reached does not rise to within 26 feet from the surface the well must, however, be fitted with a force pump, which will make the work more expensive.

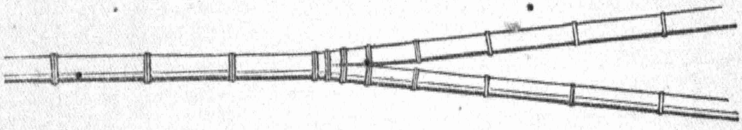
S. EARDLEY WILMOT.

BAMBOO FORKING.

I SEE a para. going the round about a bamboo having bifurcated, and as there appears to be no attempt at explanation how the phenomena is caused, I send you the following.

Some 14 years ago, while clearing a path, I came across a blossom of the kugra (*Saccharum spontanum*) that forked equally, and carried two spikes of blossom, the conversation turned on "sports," or freaks of nature, and one man said there was a forked bamboo in the village.

This I sent for and found it was true. The total length was about 30 feet, and the fork was some 10 feet up, and each bamboo was equal in size, and after forking grew as usual, except that the nodes began closer together at first, (as when growing from the ground,) and became more distant gradually as per sketch.



The independent explanation offered by two men was to the same effect, *i.e.*, that while growing, the apex of the bamboo (within the sheaths) had been pierced by one of the bamboo bugs, so common, and that it had injured the centre of axis only, and the sides grew up, and each formed a distinct axis thence.

SIBSAGAR,
12th September, 1886.

S. E. PEAL.

JARDINAGE.

IT has been suggested that the method of exploitation known as jardinage is the most generally applicable to our forests in India. This method entails the felling of trees scattered over the whole forest, the entire area being in this way worked over, either every year, or in a very limited number of years. The whole forest is continually under regeneration and contains growth of all ages.

The question I wish to ask is whether a working plan, based on this method, can arrange for grazing, and if so, how? Of course the amount of damage done by grazing depends much on the kind of forest, its situation, &c. In a pure, or nearly pure, sál forest, for instance, worked on the jardinage method, in which the grazing is very light and there is plenty of other food for the cattle, the damage done would be less than in the cases of some other forests, such as our hill-forests of oaks, maples, &c., but the question of damage is merely one of degree.

Would some of your readers kindly give me advice, and tell me whether for a forest in which grazing has to be allowed it is possible to apply the jardinage method, and if so, how?

If I am right in believing, grazing to be incompatible with the application of this method, it seems to me that we cannot adopt this method for the generality of our forests.

9th November, 1886. E. G. CHESTER.

OLD Nancy men should know that the first part of Reuss's Cours d'aménagement is now lithographed, and obtainable from the Agent Comptable at the Ecole Forestière on payment of 5·50 francs. I think it is good, and well worth buying.

F. B.

JJ. Reviews.

THE AMERICAN AGRICULTURAL DEPARTMENT, 1885.

The Report of the Commissioner of Agriculture for the United States of America for the year 1885 is a volume full of instructive reading, and may profitably be recommended to the notice of those who watch over agricultural interests in this country. The Department, as many of our readers are aware, covers a variety of interests, and undertakes numerous scientific enquiries, its scope of action including Chemistry, Botany, Microscopic research, Forestry, Seed distribution, Horticulture, Entomology and Animal Industry. The report includes the results of the year's work in each of these divisions, and concludes with a very interesting account of wheat farming in India.

The Horticultural Division undertook a series of enquiries into the origin of mildews and blights. The blight on vines had recently attracted much attention, and for many years its origin was unknown; some said that it was a sun-scald caused by the heat of the sun condensed and focussed in the lenses formed by drops of rain or dew; others urged that far from being harmful it was beneficial, since by destroying the leaves it left the vine to mature itself in the fruit. The investigations of the Department proved beyond doubt that in vines mildew is directly caused by moisture, especially in the form of heavy dew; and that plants protected by such a covering as will arrest upward radiation of heat, and prevent dew on the foliage, will escape mildew though surrounded by other mildewed plants. Thus it was shown that a vineyard to be successful must be planted in a locality where dews are light and infrequent. Similarly the blister on peach leaves was discovered to depend on sudden and extreme changes of temperature; and it is now generally admitted that proper protection by means of glass frames or screens is sufficient to preserve peach trees from this disease. The cracking of pears also depends on climatic causes, no modifications in the culture of the soil having any effect in protecting the fruit from cracking where the atmospheric conditions are unfavourable.

The Seed Division distributed large numbers of garden, field, forage and other plants to all parts of the United States, with the object of testing the merits of new plants in different loca-

lities and soils, and of increasing the annual yield by using well selected seed. More than four millions of packets of seeds were distributed in this way. Much attention also was devoted to the important and somewhat obscure subject of improving seed by crossing and hybridisation. Darwin has shown that as a rule cross fertilization is beneficial and self-fertilization injurious, and it is difficult to limit the extent to which seeds and plants may be improved by systematic and scientific efforts in this direction. In Colorado experiments were made on 300 varieties of seed-wheat obtained from all parts of the globe, and not a single sample was received which was not greatly improved in colour, yield and milling elements; so that as a result Colorado wheat is the best in the world for flour, and produces from 3 to 5 bushels an acre more than that of any other country.

The Botanical Division undertook among other things an enquiry into the possibility of naturalizing or cultivating in America foreign medicinal plants, and utilising those indigenous to the country, and the report expresses a hope that much of the large annual expenditure on drugs in foreign countries may ultimately be turned to those of home manufacture. A series of plates is given in the report containing descriptions of many of the plants referred to. But the most important work of the botanical division was an investigation into the fungous diseases of plants undertaken by Mr. F. L. Scribner. Fungi are known to be produced from minute spores given off in such immense quantities from the parent growth, that it is difficult to imagine how any plant can escape them. Fortunately, however, their germination depends upon a peculiar combination of circumstances, and much can often be done to prevent the combination from taking place. With few exceptions moisture is indispensable to fungoid growth and dryness altogether incompatible with its development; so that if plants can be kept free from moisture, especially from the condensation of dew upon their surfaces, the chief predisposing cause of disease is removed. Acting on this principle, vineyards have been protected by the use of temporary board or cloth coverings. Many fungi too, have only a limited period of growth, or develope only at certain seasons. A knowledge of their habits in this respect may be taken advantage of in guarding against or avoiding the diseases which they cause. Early planting will often secure a crop against the ravages of a late fungus, and the attacks of an early fungus may be avoided by planting late. Some of the most dangerous fungi require the support of different plants at different stages of their development, infesting a valuable plant in one stage, while in an 'alternate' condition their home may be on a worthless weed. Thus the *Ræstelia* fungus, which destroys the foliage of apple trees, has its alternate form in the blight of the red cedar, and in order to protect orchards from its ravages, it is necessary to cut down all the red cedar

trees in the vicinity. Many fungi are developed not on the surface of the plant attacked but within its tissues; these forms are particularly difficult of eradication, but much good may be done in fruit orchards by raking together and burning all fallen leaves, in this way destroying the substance, inside which the spores would otherwise germinate. Least of all should the fallen leaves be used as a material for compost, for in this case the growth of any fungoid spores within them is facilitated to a dangerous extent.

The annual recurrence of the potato murrain has been largely encouraged by the common practice of leaving in the field dead stems, leaves and tubers, which swarm with myriads of disease germs. All such should be destroyed by burning; and since darkness, heat and humidity are highly favourable to the growth of the disease, potatos should always be stored in light, cool and dry places. The subject of fungoid growth has a wider interest than is generally given to it, for many fungi which are parasitic on forest trees are often productive of great injury, and others are no less injurious to fallen timber.

Following on the Botanical section is the report of the Microscopist, whose attention was chiefly devoted to the detection of food adulteration, with special reference to butter and butterine. It was discovered that butters and animal fats being composite substances exhibit, after being boiled and slowly cooled, different forms of crystallization, and the normal crystals of the different substances can be distinguished with the greatest accuracy. The utility of these investigations can hardly be exaggerated, and their accuracy may be inferred from the fact that after one or two prosecutions for adulteration, about sixty persons in Washington, whose occupation consisted in selling as genuine butter compounds of tallow, lard and cotton-seed oil, have abandoned their calling. The report contains details of the way in which the microscopical investigations were worked out, and a coloured plate is appended showing the various crystals of butter, oleomargarine and lard as viewed with the microscope and polariscope.

In the Division of Chemistry much important work was done in analysing soils, investigating the growth of cereals, and conducting experiments in the manufacture of sugar. The sugar experiments were especially interesting. It had long been known that 50 or 60 per cent. of the sugar produced was lost either in milling or in the process of manufacture. To avoid the loss in milling it was determined to try the process of diffusion. For this purpose apparatus was erected in Kansas for cutting sorghum cane into thin strips, and extracting the sugar therefrom in a diffusion battery. The results were highly satisfactory, the degree of extraction being fully 98 per cent. Similarly, to avoid the loss incident to the usual process of manufacture, the method of carbonization was tried with entirely

satisfactory results. This process consists in adding to the juice, as it comes from the mill or the diffusion battery, a large excess of lime, which is then precipitated by blowing through the mixture a current of carbonic acid. The precipitate carries down with it all the impurities present, leaving them easily separable by filtration. The product afforded is in every way superior to that given by the old method of skimming.

In the Department of Forestry the United States are far behind most European States. $10,000 formed the whole State expenditure on forestry during the year; and the Commissioner forcibly points out the absurd smallness of this sum. Still, however, some valuable enquiries were carried on, and the results embodied in exhaustive and authoritative reports. Much information was collected by means of widely distributed circulars, to which replies were asked for. In this way the fact already strongly suspected was confirmed, that the forests in many parts of the country are decreasing at an alarming rate. There has been going on considerable tree planting in a few Western States, but wherever pines are found abundantly, the lumberman and the miner recklessly devastate enormous areas of timber-producing ground, and forest fires often complete the havoc thus begun. It is none too soon for the States to take warning, and by husbanding their resources and regulating the consumption of wood, to leave sufficient to yield a perpetual supply of wood and maintain the proper climatic conditions of moisture in the air and an equable flow of the streams.

One of the most interesting parts of the report is the chapter describing the year's work in the Entomologist's Department. The importance of the study of economic entomology receives fuller recognition year by year; and since the losses occasioned by destructive insects aggregate an enormous sum, there is obvious advantage in researches having for their object the prevention of such losses. The appearance of the so-called "seventeen year locust" over a large tract of country enabled the department to make a complete investigation into its growth and habits, and a full history of the species is under preparation. The report contains a full account of the action taken, and its value and interest are largely enhanced by a series of beautifully coloured plates.

The next chapter contains the report of the Statistician, covering the entire course of agricultural production for a period of 15 years. The tables are unusually comprehensive and complete, as may be judged from the fact that they are widely circulated and read throughout the country.

To this follows the report of the new Bureau of Animal Industry, which was established in 1884 for the purpose of preventing the importation of diseased cattle, and to provide means for the suppression and extermination of contagious diseases

among domestic animals. Pleuropneumonia in cattle, and the disease known as swine fever, formed the subject of minute investigations and experiments, all of which are described and illustrated in the report; and still more complete information is promised during the current year. The volume concludes (as already stated) with a very full and instructive account of wheat farming in India. It is pointed out how the Indian farmer, without knowledge of science and without skill, and with the rudest implements, yet in the most scientific manner, utilizes the changes of the seasons, and makes the atmosphere enrich his soil. The "glorious climate" of India is its greatest wealth, and this the untutored native uses to the greatest advantage. The land before sowing is ploughed and rooted twenty or thirty times, thus exposing every part of the soil in succession to the sun and air and to fertilization by dead and living insects. This careful preparation of the soil, combined with timely irrigation, is the reason why it has been possible to cultivate the land continuously from time immemorial, and still without exhausting it.

There are many other subjects of interest in the report, but we have mentioned enough to show its great national value.

PUBLIC RIGHTS IN RIVERS.

In the form of lease of waste lands for the W. Duars, published on December 1st, 1886, in the *Calcutta Gazette*, we find the following clause:—

"No right of fishery and no right to dam up or otherwise obstruct the passage of any streams is given by this lease. A public right-of-way over twenty yards on either bank of every stream, available at any time of the year for local boat traffic, is reserved. Public access shall be allowed at all times to any springs of water on the lands leased, whenever such access is, in the opinion of the Tehsildar or the Deputy Commissioner, necessary for the convenient supply of good water to persons residing in the vicinity."

It is a pity that Government had not been as careful to reserve fishing rights as well as rights to limestone, in all the streams in Dehra Dun.

The former would have prevented the wholesale netting of mahsir, in the spawning season, and of young fry which now goes on, and the latter would have secured a large revenue to Government. A river bed is clearly public property and should never be alienated.

III. Official Paper.

TRAINING OF INDIAN FOREST OFFICERS AT COOPER'S HILL.

General Sir A. Taylor, K.C.B., R.E., President of the Royal Indian Engineering College, Cooper's Hill, on the 16th October, 1885, in a letter to the Secretary of State proposed the appointment of Mr. H. Marshall Ward, who was strongly recommended by Sir Joseph Hooker and Mr. Thistleton Dyer, as Instructor in Botany, and recommended a salary of £450 a year, without quarters. These proposals had been discussed with Dr. Schlich, and General Taylor entirely supported them, except that he wished to have an interview with Mr. Ward before accepting him. The salary proposed is, he considered, quite a modest one, considering the work to be done, and the scarcity and cost of suitable accommodation in this neighbourhood.

Lord Randolph Churchill had previously directed that Organic Chemistry be omitted from the curriculum, on the ground that he doubted the advisability of endeavouring to impart instruction in so many subjects as were proposed. It was, however, found to be feasible to leave Inorganic Chemistry out of the College course. Room was thus made for the teaching of Organic Chemistry without any crowding of subjects, and General Taylor considered that a good knowledge of some parts of it would form quite an essential part of the education of officers who, in time to come, will be the advisers of the Government of India in its Forest Administration.

Under the arrangements now being proposed, the new Professor of Botany will teach so much of Organic Chemistry as is absolutely indispensable to the proper handling of his subject; but General Taylor concurred with Dr. Schlich in desiring that this arrangement might be considered a temporary one, and that at the end of the current session a separate Instructor should be appointed in Organic Chemistry. Indeed, independent of other considerations, a third Instructor will then be a necessity, for, according to the last time-table that has been prepared for the Forest students, there will be 23 lectures a week of about two hours each, during parts of the course, to be given in subjects

* From the Proceedings of the Government of India, in the Revenue and Agricultural Department (Forests), dated Simla, the 28th October, 1886.

connected with Forestry; and this represents an amount of work in preparation and delivery utterly beyond the power of two men.

Dr. Schlich's letter of the 10th October, 1885, to General Sir A. Taylor follows, in it we read—

His Lordship in Council has accepted the proposed course of studies as a whole, but it has been ruled that Organic Chemistry and Biology shall be omitted from the curriculum, at least for the present, His Lordship having some doubt as to the advisability of endeavouring to impart instruction in so many subjects. With all due deference to higher authority, Dr. Schlich expressed sincere regret at the modifications which have been ordered to be introduced, stating that biology, and more especially a knowledge of the insects which attack living trees and timber, was becoming of greater importance every year. He referred to a tour through extensive forests of teak poles in Berar (*Melghat Reserves*) in which almost all the trees had been attacked by an insect, causing serious injury to them; but, up to date, it had not been possible to ascertain either the name of the insect or its special habits, much less to suggest a cure or prevention of such damage. Experience in India had convinced Dr. Schlich that Forest Officers must in future bestow much more attention on Entomology than had been done hitherto, and he expressed regret that the orders mentioned above would prevent the necessary instruction being given in the new Forest Class at Cooper's Hill in the manner originally contemplated. He still hoped that the subject might be favourably re-considered by the time the first year's course closes.

As regards Organic Chemistry, Dr. Schlich asked for early re-consideration of the orders. A knowledge of certain parts of Organic Chemistry was absolutely necessary, if the students were to derive any benefit from the course of instruction. It is quite out of the question to study Botany properly, or to understand a variety of questions connected with Forestry specially, without some knowledge of Organic Chemistry, and there would be great difficulty in arranging the course of studies successfully unless the present contention was admitted. Moreover, it was found that the five Forest students who have just joined at Cooper's Hill College are all fairly well acquainted with Inorganic Chemistry, so that the necessary time for the study of Organic Chemistry was at once available without risking or attempting instruction in too many subjects.

Although it would be necessary to arrange, at no distant future, for special instruction in Organic Chemistry, with the view of meeting the wishes of His Lordship in Council, inquiries were made for an Instructor in Botany, who could also teach the most necessary acquirements in Organic Chemistry. Sir Joseph Hooker and Mr. Thiselton Dyer, of Kew Gardens kindly assisted in this matter, and recommended Mr. H. Mar-

shall Ward, as thoroughly fit to undertake the required instruction in the various sections of botanical knowledge, and in those parts of Organic Chemistry which it is necessary to know for the understanding of Botany. Mr. Ward is a graduate of the University of Cambridge; he took his degree in 1879, having obtained first class honours in Botany in the Natural Science Tripos. He was elected a Fellow of Christ's College, Cambridge, in 1883. He has also worked under Professor Sachs in Würzburg, and under Professor De Bary in Strassburg, as well as in the Jodrell Laboratory at Kew. After taking his degree, Mr. Ward was deputed to Ceylon for two years to investigate the coffee-leaf disease, and on his return he was appointed Assistant Lecturer in Botany at Owen's College, Manchester, which post he now holds.

Mr. Ward has a considerable amount of experience in teaching, and had shown himself to be an original investigator, and was most highly recommended by a number of gentlemen. Mr. Thiselton Dyer also considers Mr. Ward thoroughly fitted for the work, and in fact, that he is the best man available for the post, and the Secretary of State's sanction to the appointment of Mr. Ward on a salary of £450 a year was solicited. The expenditure now proposed would be about £200 below the total of £600 to £700 originally proposed in paragraph 9 of my Memorandum, dated the 22nd May, 1885.

If appointed, Mr. Ward would, during the first year of the course, give to the Forest students a short course of lessons on certain chapters of Organic Chemistry; then would follow Organography, Vegetable Physiology, and general Systematic Botany. During the second year he would take up, more in detail, the structure of wood, diseases of trees, and make the students acquainted with the principal trees and shrubs of British India. Mr. Ward would also get together a small herbarium for purposes of instruction only, diagrams, and other objects required for the illustration of his lectures.

In reply to this proposal, the Secretary of State sanctioned the appointment of Mr. H. Marshall Ward as Instructor in Botany upon the terms suggested (£450 a year, without quarters, no claim to pension, and the engagement terminable on a term's notice).

Lord Randolph Churchill was also pleased to approve of Sir A. Taylor's proposals for the substitution of instruction in Organic Chemistry and in Botany, for instruction in Inorganic Chemistry, during the first year's course, and a further report relative to the necessity for appointing a separate Instructor in Organic Chemistry was called for towards the end of the year's course.

The Secretary of State promised then to consider the question of the necessity, again urged by Dr. Schlich, of instruction in Biology, and on the 20th July, 1886, Sir A. Taylor forwarded

for favourable consideration, a copy of Dr. Schlich's letter of the 7th current, urging the necessity of special teaching in Biology (Entomology) in the case of the Forest students, and proposed the appointment of Mr. Shipley as Instructor in that subject.

Sir A. Taylor hoped that the Secretary of State for India would assent to Dr. Schlich's proposals to postpone the required report as to the necessity for a special teacher of Organic Chemistry till towards the end of next session, and to limit the study of Forest Law to the reading of Baden-Powell's "Manual of Jurisprudence for Forest Officers."

Dr. W. Schlich's letter of the 7th July, 1886, contains the following :—

I have nothing to deduct from the arguments set forth in my letter of the 10th October last; in other words, I consider adequate instruction in Entomology absolutely necessary, if justice is to be done to the work which Her Majesty's Secretary of State for India has been good enough to entrust to me. I have accordingly the honour to submit, for your consideration and submission to the Secretary of State for India in Council, the following proposals :—

"I propose that the Forest students shall, during the second year, devote every Saturday morning to the study of Entomology, preceded by so much (and no more) of general Biology as is required to understand the former. The instruction would consist of, say, a lecture of an hour's duration, followed by not less than two hours' practical laboratory work. There are altogether about 33 Saturdays available, but it is calculated that 30 will be sufficient for the instruction which is now proposed.

"With the view to securing the services of a competent Instructor, I have communicated with Professor Huxley, who referred me to Professor M. Foster, of Cambridge. The latter gentleman has been kind enough to recommend to me Mr. A. Shipley, a teacher in Biology at Christ College, Cambridge. Professor Foster informs me that Mr. Shipley is one of the very best teachers in biological subjects which they have at Cambridge.

"I have had an interview with Mr. Shipley, and I am satisfied that he will be able to do justice to our work. It is true that he has not hitherto taken up Entomology as a speciality, but he is anxious to work up the subject; and, as a matter of fact, it would be almost impossible to secure the services of an Instructor of the modern school of Biology who is, at starting, conversant with the details of Entomology.

"Mr. Shipley would come over from Cambridge every Saturday, commencing with the ensuing autumn term, and he would, on each visit, devote not less than three hours to the students. His visits would not exceed 30 in number, and he is willing to undertake the work for a fee of £100 (one hundred pounds), which, considering the circumstances, appears a moderate sum. I propose that he may be appointed Instructor in Entomology,

under the usual conditions as regards cancellation of the appointment.

"Before bringing this letter to a conclusion, I beg to state that I do not intend to make any further proposals regarding the instruction in Organic Chemistry until the end of the second year, when actual experience will enable me to state accurately in how far present arrangements meet our requirements, and in how far further help is required.

"I also propose to restrict the study of Forest Law for the present, in deference to the expressed wish of Her Majesty's Secretary of State for India in Council, to the reading with the students of Baden-Powell's "Manual of Jurisprudence for Forest Officers," of which work I beg ten copies may be supplied on an early date. This will further increase the work of the Forestry Professor, which, as you are aware, is already very heavy; but, under existing orders, this cannot be helped. At the same time, there seems little doubt that it will be necessary to appoint two officers when I surrender the post—a matter which, however, need not be considered at present."

On the 3rd September, 1886, the Secretary of State for India replied that, in the present condition of the finances of India, His Lordship did not feel justified in giving his sanction to the appointment of a special teacher of Entomology for the benefit of the Forest students at Cooper's Hill, as proposed by Dr. Schlich and yourself.

Irrespective, moreover, of this consideration, Lord Cross was of opinion that, looking to the risk of overwork involved in the multiplication of subjects alluded to in my letter of the 1st August, 1885, the decision expressed at the same time as to the omission of Biology from the course of instruction should be adhered to, unless it be possible to substitute that subject for some other which may be held to possess smaller importance.

REPORT

ON

A BOTANICAL TOUR IN MERWARA (RAJPUTANA)

MADE IN

JANUARY 1886

BY

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REPORT

ON

BOTANICAL TOUR IN MERWARA (RAJPUTANA)

MADE IN

JANUARY 1886.

I left Agra by train on the 2nd of January for Beáwar in Merwára arriving there on the following afternoon.

After making the necessary arrangements, through the tahsildar, for camels, &c., I started the next morning in the direction of Todgarh, formerly a large missionary station. This place is on the top of the Aravalli range of hills, and is distant about 50 miles south of Beáwar.

The country in the immediate neighbourhood of Beáwar is comparatively flat. There is a good road to Todgarh, level as far as Jawájar, which is the first halting-stage. After this it becomes more and more of a hill road, winding through fertile valleys, and eventually traversing a portion of the Aravalli range within a few miles of Todgarh. Portions of the level section of the road between Beáwar and Jawájar are well shaded by trees of various kinds, including the following:—

Acacia arabica (*babul*), together with the cupressiform variety).
A. leucophlœa (*arinj*).
Albizzia Lebbek (*siris*).
* Balanites ægyptiaca (*hingota*).
Dalbergia Sissoo (*shisham*).
* Melia indica (*nim*).
* Pongamia glabra (*kurrus*).
* Prosopis spicigera (*khejra*).
* Salvadora persica (*jal*).
Tamarix gallica (*jhau*).

I have marked with an asterisk those which appeared to me to be most suitable for the purpose, as they thrive well and give good shade. *Shisham* should be planted only where it can get plenty of moisture at the roots. In saline soils, of which I saw frequent evidences alongside this road, *arinj*, *khejra*, and *jhau* are suitable.

I noticed several patches of reh efflorescence on the low-lying parts, but its effect on the vegetation, both cultivated and spontaneous, struck me as being far less injurious than is the case in the doab of the Gangetic plain, where I had recently been travelling. Whether this difference be due to different chemical composition of

the reh, or to mechanical causes resulting from the configuration of the country and its effect on the surface drainage, I had no sufficient means of ascertaining. On a patch of pure efflorescent reh, in addition to the usar grass (*Sporobolus tenacissimus*), dáb (*Eragrostis cynosuroides*), and other characteristic species, I gathered some quite healthy specimens of dub grass (*Cynodon Dactylon*), which last is not to be found on anything approaching bad usar land in the North-West Provinces.

The Jawájar inspection bungalow is prettily situated on some rising ground which overlooks a large sheet of water, the Jawájar tank. There are some remarkably fine specimens of *kikar* and *Ficus* close to the bungalow, which make it pleasantly cool and shady.

After leaving Jawájar the country becomes more hilly, and the vegetation alters considerably. The hills in this part are all unreserved, and open to promiscuous grazing. The following is a list of the plants which characterize the vegetation of these dry unpromising-looking hills:—

Acacia Jacquemontii.
„ leucophlœa.
„ Senegal.
Andropogon foveolatus.
Anogeissus pendula (greatly altered in habit from exposure).
Aristida, *spp.*
Arthraxon echinatum.
Balanites Roxburghii.
Balsamodendron Mukul.
Calotropis gigantea.
Capparis aphylla
Crotalaria Burhia.
Dæmia extensa (climbing over bushes).
Dichrostachys cinerea.
Eragrostis bifaria.
„ ciliaris.
Euphorbia Nivulia.
Fagonia arabica.
Grewia pilosa.
„ populifolia.
Gymnosporia montana.
Heteropogon contortus.
Indigofera cordifolia.
„ enneaphylla.
Lepidagathis Hamiltoniana.
„ trinervis.
Melanocenchris-Royleana.
Oropetium Thomaum.
Orthanthera viminea.
Prosopis spicigera.
Rhus mysorensis.
Rhynchosia minima.
Tephrosia purpurea.
Tragus racemosus.
Tribulus terrestris.
Vernonia cinerascens.
Vitis carnosa.
Vogelia indica.
Zizyphus nummularia.

The reserved tracts contain the same species; but, owing to shelter and protection, many of them are not easily recognized as being identical with the misshapen and stunted forms to which exposure and overgrazing reduce them.

From Jessalhera, where I halted for a night, the road crosses over

a portion of the Aravalli range, descending on the further side to a place called Bhim, where there is another large lake, or tank.

From the hills above Bhim there is a fine view looking south. A comparatively flat piece of country stretches between the Aravallis and the grotesquely-shaped hills in the direction of Udaipur, and which stand up like islands on the distant horizon. The intervening plain is covered with jungle scrub, varied with patches of cultivation, and dotted, here and there, with tanks resembling miniature lakes.

My next march was to Todgarh, where I found the Commissioner's camp and that of Mr. Whiteway, the Settlement Officer, who most kindly treated me as his guest during the remainder of my time in Merwára. Mr. Lowrie, the Forest Officer, was also of the party, and I am greatly indebted to him for much valuable information concerning the forest vegetation of the district. His knowledge of the history of the forest reserves was of great assistance in enabling me to compare the results of protection over certain periods of time. These experiments are most interesting and decidedly encouraging, and I fail to understand how any one can say that the system will not ultimately bring benefit to the people. The appearance of an ordinary Merwára hillside which has been left open for grazing for an unlimited number of years is indeed a melancholy one. The constant cropping by sheep and goats, and the tread of cattle, prevents the growth of young trees and shrubs, whilst those which have not been actually destroyed become dwarfed and lose their characteristic habit. It is at this stage that the protection formerly so much needed for the proper development of the trees and shrubs, is assumed by the plants themselves in the shape of thorns. The survivors in the struggle for existence, for the most part normally armed with thorns, add to their armour, and are able to resist attacks for an indefinite period. In its present condition such a hillside is of little use either to man or beast. Mr. Lowrie showed me a very striking instance of the good effects of protection even for so short a period as two years. Between Bhim and Ákhajitgarh there is a piece of reserve known as the Amnir block, which was closed in 1884. Alongside this, and on the opposite side of the valley the ground is open to grazing. The change that has taken place within the protected area is very striking, and can be seen from a long distance off. A close examination of the plants themselves reveals their marvellous recuperative power. The energy which was pent up in a bush of thorns is manifested in the development of healthy shoots. The general appearance of a reserved block of this age is that of an English copse. The effect on the growth of grass when protected and sheltered is equally striking, and one would naturally suppose that the villagers would gladly avail themselves of

the privilege of being allowed to cut grass for fodder in these reserves, but the people of Merwára are ultra-conservative on all questions of reform: It has been their custom for generations past to let their cattle and goats roam at will through the jungles, and consequently they do not take kindly to the present system which necessitates the cutting and removal of the grass; a large quantity of grass therefore is left uncut.

On the day after my arrival at Todgarh, Mr. Lowrie took me to see a "Dhaukra" forest. The dhaukra (*Anogeissus pendula*), is a very local tree, being confined to limited tracts of Central and Northern India. Its appearance from a distance is more like that of a willow. In addition to this interesting tree, I had the pleasure of seeing many other trees and shrubs which I had not before met with in a wild state. Descending to the bottom of a valley we reached a rocky stream with its edges fringed with the maidenhair-fern (*Adiantum Capillus-Veneris*). Here also I gathered beautiful flowering specimens of *Canscora diffusa*, a plant belonging to the Gentian family, and of a small terrestrial orchid, *Zeuxine sulcata*. Many other specimens were collected to which allusion will be made in the general list appended to this report.

From Todgarh we marched to Barár, and thence to Bhim, and then on to Akhajitgarh, where there is a very picturesque tank, reminding one of a miniature Scotch lake. The crests of the hills above this place are well clothed with "Saler" trees (*Boswellia serrata*). The foliage is given as fodder to buffaloes, and the trees are often pollarded for the purpose.

From Akhajitgarh we proceeded to Táragarh over a rather wild rocky bit of the Aravallis, and thence to Motla, passing through fine forests composed chiefly of saler, dhák, dhaukra, and ber (*Zizyphus Jujuba*). After Motla we came to Bár, a march of 12 miles through extensive forests. Forming part of the undergrowth of these forests is a species of Saccharum (*S. Nareya*) called "Panni," which is the name given to the "khas-khas" grass further north, whilst the latter is known as "gándar" in Merwára. A handsome species of Hibiscus (*H. Gibsoni*) was found; the flowers are bright yellow, and purple at the base.

At Bár I had to take leave of my friends Colonel Trevor, Mr. Whiteway, and Mr. Lowrie, whose kindness and hospitality I shall always remember with gratitude. I arrived at Beáwar on the morning of the 17th, and left by mail train for Saháranpur.

The following list includes the majority of the plants observed by me during the fortnight I spent in Merwára last January, with the addition of several others, of which specimens were received from Mr. Lowrie, and which were collected by him in Merwára and in the neighbourhood of Ajmir. I have also added the names of a few

plants mentioned by Dr. Brandis in his Report on the Forests of Ajmir and Merwára, published in 1879; as well as others recorded by Dr. King in his Paper on the Flora of Rájputána, published in the *Indian Forester*. I have made free use of Dr. Brandis' List of Local Vernacular names given in his abovementioned report.

This list is, of course, very far from complete, and even after consulting all the available materials, of which the richest source exists probably in the herbarium of the Calcutta Botanical Garden, many additions might be made by further explorations at other seasons of the year.

Anonaceæ—

Saccopetalum tomentosum, Hk. f. & T.—Vern. "umbia" or "umbi."—The leaves are used as fodder.

Menispermaceæ—

Tinospora cordifolia, Miers.—Aravalli hills. A climbing shrub, with cordate leaves. A drug called "Gilo" is prepared from this plant.

Cocculus villosus, DC.—A climbing shrub, with greyish silky leaves and purple berries. The plant is used in native medicine.

C. *Leœba, DC.*—A climbing shrub inhabiting dry countries. It is called "Vallur" in the Punjab.

Cissampelos Pareira, L. (K.)[1]—The leaves and roots are medicinal.

Papaveraceæ—

Argemone mexicana, L.—Introduced and naturalized, spreading extensively as a weed over waste ground, and on newly-turned soil. Has been recommended as fodder in the form of silage.

Fumaria parviflora, Lamk.—Cultivated ground; common.

Cruciferæ—

Sisymbrium Irio, L.—Vern. "parjan." Cultivated fields. Merwára.

Diplotaxis sp.—Vern. "parjan." Roadside and cultivated ground. Merwára.

Capparideæ—

Gynandropsis pentaphylla, DC.—Waste places; common.

Mœrua arenaria, Hk. f. & T.—Not uncommon.

[1] The letter "K" after the name of a plant refers to Dr. King's paper in the *Indian Forester*.

Cratæva religiosa, Forst.—Vern. "barana" or "varana." Merwára. (*A. E. Lowrie.*)

Capparis aphylla, Roth.—Vern. "kher." Known as "karil;" further north.

C. sepiaria, L.—Vern. "katán."

C. horrida, L. F.—Vern. "gitoran."

C. spinosa, L. (K.)—A small shrub. Not common. The flower-buds of this plant are the caper of commerce.

Bixineæ—

Flacourtia Ramontchi, L'Herit.—Vern. "khakeran." A prickly shrub or small tree with edible berries.

Polygaleæ—

Polygala erioptera, DC.—Common.

Caryophylleæ—

Spergula arvensis, L.—Cultivated ground.

Saponaria Vaccaria, Linn. (K.)—Cultivated ground.

Polycarpon Læflingiæ, Benth. & Hk. f.—Ajmir. (*A. E. Lowrie.*)

Portulaceæ—

Portulaca quadrifida, Linn.—Vern. "pattar phor." A curious-looking plant, with fleshy stems and leaves. In Merwára it is usually found in the crevices of rocks.

Tamariscineæ—

Tamarix gallica, Linn.—Vern. "jhau." A shrub or small tree, common in saline soil.

T. dioica, Roxb.—Vern. "jhau." A shrub common on wet saline soil.

T. ericoides, Rottb.—Vern. "javra." A shrub resembling a *Myricaria* in habit. I have specimens gathered by Mr. Lowrie near Todgarh, which must be very near its northern limit in India.

Elatineæ—

Bergia odorata, Edgew.—A few specimens of this rare plant were found beside a watercourse, on the Aravalli hills near Ákhajitgarh.

B. æstivosa, W. & A. (K.)

Malvaceæ—

Sida grewioides, Guill. & Perr.

S. cordifolia, L.—Common.

Abutilon asiaticum, G. Don.—Vern. "meda pata." Todgarh. Specimens of other species were gathered, but have not yet been determined.

Pavonia odorata, Willd.—An erect glandular herbaceous plant, with pink flowers. Common on the Aravalli hills.

Hibiscus micranthus, L.—A scabrous shrub, with long slender stems. Common in Merwára.

H. Solandra, L'Herit.—Merwára. (*A. E. Lowrie.*)

H. Gibsoni, Stocks.—A prickly shrub. Flowers large, handsome yellow with purple at the base. Not common in Merwára.

H. ficulneus, L.—Merwára. Roxburgh, in "Flora Indica," iii, p. 208, under his description of *H. strictus*, now regarded as a synonym of *H. ficulneus*, writes :—

"Like many other of the *Malvaceous* tribe, the bark of this species abounds in flaxen fibres; but in none have I found so large a quantity equally beautiful, long, glossy, white, fine and strong, as in this. To these promising qualities may be added the luxuriant growth and habit of the plant, rendering it an object deserving of every care and attention, at least until the real worth of the material is fairly ascertained."

Gossypium herbaceum, L. var., *obtusifolium*?—Mr. Lowrie drew my attention to the existence of a wild cotton in the forests of Merwára, where it is known under the names of "irban" and "ban kukri." I saw several plants in a forest to the west of Barár, with certainly all the appearance of being indigenous. Some of the specimens were in fruit, from which I intend to raise plants for future examination. The natives do not appear to make any use of this cotton.

Bombax malabaricum, DC.—Vern. "semla." This is the cotton-tree or "simal" of other parts of Northern India.

Sterculiaceæ—

Sterculia urens, Roxb.—Vern. "kurr." A medium-sized deciduous tree, with white bark and greenish-yellow flowers. It yields a white gum, which is called "Katira," and is collected in other parts of India. In Merwára it grows on dry rocky hills in company with "saler" (*Boswelia serrata*).

S. colorata, Roxb.—Vern. "mutruk." A medium-sized tree, with crimson flowers. Rare in Merwára.

Helicteres Isora, L.—Vern. "marorphali." A shrub, or small tree, with red flowers and spirally twisted carpels. The bark

yields a useful fibre, and the leaves and fruits are used medicinally in other parts of India.

Melhania futteyporensis, Munro.—A shrub, covered with white pubescence, flowers yellow. Common in Merwára, where it forms a certain portion of the undergrowth in the "dhaukra" forests.

Tiliaceæ—

Grewia populifolia, Vahl.—Vern. "gangan," "gangerun," or "ganejan." A small shrub, with slender branches and white flowers. The slightly pulpy fruit is eaten. In a forest near Todgarh I saw several shrubs covered with lac. This shrub is very common on the dry hills of Rájputána.

G. salvifolia, Heyne.—Vern. "heriss," "seriss," "sarisa," or "katang." A common shrub on the dry rocky hills of Merwára. The underside of the lanceolate leaves is white, and the flowers are yellow.

G. asiatica, L.—Vern. "phalsa" or "atia dhamin." A broad-leaved species, with red and yellow flowers and edible fruit.

G. vestita, Wall.—Vern. "dhamin" or "hása dhamin." Associated with the preceding. Dr. Brandis in his Report on the Forest Administration in Ajmere and Merwára, p. 13, remarks—

"It has been doubted whether these last two (*G. asiatica* and *vestita*) should be regarded as species or merely as varieties, but in these hills they are quite distinct, and it seems probable that the mother plant of the Phalsa (*Grewia asiatica*), a fruit commonly cultivated in gardens throughout North India, is wild on the dry hills of the Aravalli range."

G. pilosa, Lamk.—Vern. "pisangan," "parangan," or "phrongli." A straggling shrub, with angular and fluted stems. Very common on the dry hills of Merwára.

G. vilosa, Willd.—Vern. "dhokelan." A small shrub, with round softly hairy leaves. Todgarh forests and other parts of Merwára.

G. denticulata, Wall.—Merwára. (*A. E. Lowrie.*)

Triumfetta rotundifolia, Lam.—I have specimens of this plant collected in Merwára by Mr. Lowrie in 1884.

Zygophylleæ—

Fagonia arabica, Linn.—Vern. "jowasa." (Ajmir.) A small spiny shrub with linear leaves and rose-coloured flowers. Common on sandy ground.

Geraniaceæ—

Monsonia senegalensis, Guill. & Perr.—A few specimens of this interesting plant were given to me by Mr. Lowrie, who found it at Todgarh about two years ago.

Impatiens Balsamina, L.—Merwára. (*A. E. Lowrie, 1884.*)

Rutaceæ—

Limonia acidissima, L.—Vern. "keiri" or "kari."

Ægle Marmelos, Correa.—Vern. "bilan."

Peganum Harmala, L. (K.)—A small shrub.

Simarubeæ—

Balanites Roxburghii, Planch.—Vern. "hingota." A thorny shrub or tree. In Rájputána they use the pulp of the fruit for cleaning silk.

Burseraceæ—

Boswellia serrata, Roxb.—Vern. "saler." A common tree in Merwára, found chiefly on the crests of the hills. The foliage of this tree is much used as cattle fodder.

Balsamodendron Mukul, Hook.—Vern. "gugal." Dr. Brandis describes this plant as

"A stunted deciduous shrub with thick spreading branches, bark ash-coloured, peeling off in rough flakes, leaving exposed the under bark, which is bright and shining, and peels off in rolls like thin paper. This shrub yields a fragrant gum-resin, which is similar to the Myrrh of commerce.

Not uncommon on some of the Merwára hills.

Meliaceæ—

Soymida febrifuga, Adr. Juss.—Vern. "rohan." I have specimens from near Todgarh. It is rare in Merwára.

Celastrineæ—

Celastrus paniculatus, Willd.—Vern. "kanguni bel." Dewair forest, Merwára. (*Brandis.*)

Gymnosporia montana, Roxb.—Vern. "kakaira." A prickly shrub, with greyish-coloured foliage, very common on all the Merwára hills. The leaves are used for fodder.

G. Roylcana, Wall. (K.) Syn. *Celastrus spinosus, Royle.*—A thorny shrub.

Rhamneæ—

Zizyphus nummularia, W. & A.—Vern. "bhor," "jhalbhor." Very common.

Zizyphus xylopyrus, Willd.—A large spreading shrub or smal tree. The leaves and fruit are given to cattle and goats as fodder, and the bark and fruit are used in dyeing and tanning.

Ampelideæ —

Vitis latifolia, Roxb.—Vern. "musal," "murie." A large climber.

V. indica, L.—A large climber.

V. carnosa, Wall.—Vern. "katamba." Common.

Sapindaceæ—

Cardiospermum Halicacabum, L.—I have specimens collected in Merwára by Mr. Lowrie in 1884.

Sapindus trifoliatus, L. Syn. *S. emarginatus, Vahl.* ("Soap-nut.")—Vern. "ritha," "aritha." Indigenous in the southern part of Merwára, where the seed is collected and sold. (*Brandis.*)

Anacardiaceæ—

Rhus mysorensis, Heyne.—Vern. "dasan," "davan," "dasni." A thorny aromatic shrub, with edible berries; the bark is largely used for tanning purposes.

Odina Wodier, Roxb.—Vern. "gol." A deciduous pinnate-leaved tree, valuable on account of its timber and for making charcoal. It is often found in company with the "Saler" (*Boswellia serrata*).

Semecarpus Anacardium, L. (K.)—A moderate-sized tree. The astringent bark and acrid oily fruits are used for a variety of purposes.

Buchanania latifolia, Roxb. (K.)—Vern, "chár." A medium-sized tree. It yields a variety of useful products, the most important perhaps being the kernel of the fruit, called "chironji."

Moringeæ—

Moringa concanensis, Nimmo.—Vern. "soonjna," "sainjna," "segora," "hegu," "segu." Rather handsomer than the common Horseradish tree (*M. pterygosperma*).

Leguminosæ—

Crotalaria Burhia, Ham.—Vern. "kausta." Ajmir. A small stiff shrub, with yellow flowers Common on sandy ground. Other species of Crotalaria were gathered, but have not yet been determined.

Crotalaria mysorensis, Roth., var. *luxurians*.—Aravalli hills.

Trigonella polycerata, L.—A small clover-like weed, growing in cultivated ground.

Melilotus parviflora, Desf.—Vern. "morla." A common weed on cultivated land.

Indigofera cordifolia, Heyne.—Vern. "vekriavas." An annual, with sessile cordate leaves, and bright red flowers. Very common all over the Merwára hills.

I. enneaphylla, L.—A prostrate plant, with long wiry stems, and small crimson flowers. Abundant on ground which has been flooded.

I. paucifolia, Del.—A small shrub, with pinkish flowers. Mr. Lowrie has given me specimens of this, also of *I. hirsuta, L.*, gathered near Bágri, in Merwára.

I. argentea, L., var. *cœrulea*.—Vern. "nil." A canescent shrub, with reddish-yellow flowers. Aravalli hills.

Tephrosia purpurea, Pers.—Common.

Alhagi maurorum, Desv.—Vern. "jawasa." A small prickly shrub, with red flowers and moniliform pods. It is known in Upper India under the name of "Camel-thorn."

Aeschynomene indica, L.—An erect viscid herb. Common

Alysicarpus bupleurifolius, DC.—Aravalli hills. Examples of other species were gathered, but have not yet been determined.

Desmodium gangeticum, DC.—Forests about Todgarh

Abrus precatorius, L.—Vern. "chirmi." A climbing plant, with white or rose-coloured flowers, and usually bright red seeds.

Mucuna pruriens, DC.—A climbing annual. Pod covered with stinging hairs.

Erythrina suberosa, Roxb.—Vern. "gadichora."

Butea frondosa, Roxb.—Vern. "chora," "sltora," "khakra," "kankra" (dhak" of Upper India). "Common wherever there is a sufficient depth of soil, in depressions in valleys, and on level ground." (*Brandis.*)

Pueraria tuberosa, DC.—Vern. "gora bel." A twining shrub; with racemes of blue or purplish flowers. It has tuberous roots, which grow to an enormous size. These tubers are eaten, and are also used medicinally. I have been told that the dak horses on the Umballa-Kalka line are fed on slices of these tubers during the hot weather, when other fodder is scarce. The foliage of this plant is a well-known and favourite fodder at Mount Abu and its neighbourhood. It is very common all along the base of the North-Western Himalayas

Rhynchosia minima, DC.—Common everywhere, climbing over shrubs.

R. viscosa, DC.—Ajmír. (*A. E. Lowrie.*)

Dalbergia latifolia, Roxb.—Vern. "shisham." I saw specimens near Todgarh, which, according to Brandis, is about its north-west limit. This is the Rose-wood tree of Southern India.

D. lanceolaria, L.—Vern. "passi."

Cæsalpinia Bonducellæ, Fleming.—Merwára. (*A. E. Lowrie.*)

Parkinsonia aculeata, L.—Vern. "vilayati kikar." A prickly shrub, becoming naturalized in North-Western India. It is a native of America and the West Indies.

Cassia Fistula, L.—Vern. "kirmalia," usually known under the name of "amaltás." Apparently rare in Merwára. I remember noticing one tree in a forest near Todgarh.

C. Sophera, L.

C. auriculata, L.—Vern. "awal." Common.

C. Kleinii, W. & A.—Todgarh.

C. pumila, Lamk.

C. glauca, Lamk. ?—Merwára. (*A. E. Lowrie.*)

Bauhinia racemosa, Lamk.—Vern. "jhinga," "jija." A small crooked-growing tree; the inner bark yields a strong fibre.

B. purpurea, L. (K).—"The khairwail" of Northern India.

Prosopis spicigera, L.—Vern. "khejra." A thorny tree, very common in Rájputána, as well as in the Punjab and Sind, where it is called "jhand." The wood is good for making into charcoal; and the pods, like those of the Mezquit tree (*Prosopis juliflora*), are edible. Altogether a useful tree for planting on waste lands.

Dichrostachys cinerea, W. & A.—Vern. "kheri" (Ajmír), "kunlai," "kanlai" (Merwára). A stiff thorny shrub, or small tree. The flowers are in spikes, the upper fertile ones yellow, and the lower sterile white or purple. Easily distinguished when in fruit by the curiously twisted pods. Not uncommon in Merwára.

Mimosa rubicaulis, L.—A large thorny shrub, with rose-coloured globular heads of flowers.

Acacia arabica, Willd.—Vern. "babul." This most useful tree, also called "kikar," is quite naturalized in Rájputána and in other parts of North-Western India. The cupressiform variety also occurs.

A. Jacquemontii, Benth.—Vern. "baonli." Rather a pretty shrub, with reddish stems, pure white thorns, and heads of sweet-scented yellow flowers, like those of the "babul." It is found usually on sandy ground. The leaves are used as fodder.

Acacia leucophlœa, Willd—.Vern. "árinj." A small tree common in Merwára. The flowers are pale yellow, in globular heads, and the long slightly curved pods, crowded at the end of the branches, at once distinguish this tree from other Indian species. A useful tree to plant in poor soils. The leaves are used as fodder, but the pods are said to be poisonous.

A. Catechu, Willd.—Vern. "khair," "kari." A moderate-sized tree, with yellow flowers in spikes, and thin cartilaginous pods. A very useful tree, common in Merwára, and sowing itself freely.

A. Senegal, Willd. Syn. *A. rupestris, Stocks*—.Vern. "kumta." A robust thorny shrub, common on the dry Merwára hills, and characteristic of the more arid parts of India, extending to Arabia and Africa.

A. Intsia, Willd., var. *cœsia*.—Forest between Todgarh and Barár. A prickly climbing shrub, with pale yellow flowers in globose heads.

Albizzia odoratissima, Benth.—Vern. "kalai," "kála siris." A large handsome tree. The heartwood is dark brown, hard, and durable. The foliage is given to cattle as fodder. Brandis, in his report on the Merwára forests, says:—

"The black siris * * * is probably one of the most promising constituents of these forests. The tree is common on all the reserves from Nágpahár to Dewair."

Combretaceæ—

Terminalia belerica, Roxb.—Vern. "bahera." A large tree, useful chiefly for its fruit, which is much used in dyeing and tanning. Cattle and other animals are very fond of it.

T. Arjuna, Bedd. (K.)—A large tree in some parts of India, with the trunk often buttressed. The bark is used medicinally.

T. tomentosa, W. & A.—A large tree, capable of yielding a great variety of useful products; amongst others, the leaves afford good fodder.

Anogeissus latifolia, Wall.—Vern. "gosia" or "golia dhau." (Merwára.) A large handsome tree, affording excellent timber and fuel, and a gum, which is used in cloth-printing; the leaves are much used for tanning.

A. acuminata, Wall.—A handsome tree, growing to a large size, if allowed to do so. Mr. Lowrie showed me a fine specimen near Barár, which now shelters a shrine, and has thus escaped destruction.

A. pendula, Edgew.—Vern. "dhau," "dhaukra," "dhokra." This is an important tree, forming extensive forests in certain

parts of Rájputána, as at Todgarh on the Aravalli hills. It is a handsome tree when well grown, and is easily distinguished by its drooping branches. The fruit ripens in January, and by this time the foliage has assumed a purplish-brown tint, which is very striking. Some seed I collected in Merwára has germinated very fairly in the Saháranpur garden. I have not heard of any successful sowings elsewhere.

Myrtaceæ—

Eugenia Jambolana, Lam.—Vern. "jambu." I gathered near Todgarh specimens of a narrow-leaved variety of this tree, possibly a different species.

Lythraceæ—

Ammania sp.—Near water.

Woodfordia floribunda, Salisb.—Todgarh forests and elsewhere.

Lawsonia alba, Lamk.—Vern. "mehndi." Not common. (*Brandis.*)

Samydaceæ—

Casearia tomentosa, Roxb. (K.)—A small tree.

Cucurbitaceæ—

Cucumis prophetarum, L.—Aravalli hills.

Citrullus Colocynthis, Schrad.—Vern. "indrayan." On sandy soil.

Cacteæ—

Opuntia Dillenii, Haworth (K.)—The Prickly Pear. Introduced and naturalized

Ficoideæ—

Trianthema monogyna, L.—A common weed.

T. crystallina, Vahl.—Vern. "pattar phor." Sandy soil.

T. pentandra, L.—A common weed in Merwára.

Mollugo hirta, Thunb.—On rocks and sandy ground, Merwára.

Rubiaceæ—

Stephegyne parvifolia, Korth.—A large tree, foliage used as fodder. Todgarh forests and elsewhere.

Hymenodictyon excelsum, Wall.—Vern. "lunia," "lamkana." A

small tree in Merwára. The foliage is given to cattle as fodder.

Randia dumetorum, Lam.—Vern. "ghatolan," "karumba." A shrub or small tree, not common. The leaves are used as cattle fodder. (*Brandis.*)

Gardenia turgida, Roxb.—Vern. "karumba." A small tree, not uncommon in the Merwára forests.

Hamiltonia suaveolens, Roxb.—Vern. "padera." A small shrub. The leaves and stems, when bruised, give off an offensive smell.

Spermacoce sp.—Aravalli hills.

Compositæ—

Vernonia cinerea, Less.—A common weed.

V. cinerascens, Schultz.—Vern. "lalia" or "káli harr." A small shrubby plant, with white branches and claret-coloured flowers. Not uncommon, growing up with the "tor" bushes (*Euphorbia Nivulia*).

Cyathocline lyrata, Cass.—By water.

Blumea amplectens, DC.—A common weed, on waste ground.

Pluchea lanceolata, Oliv.—Vern. "chota kalia" (Ajmir). A coarse weed, and difficult to eradicate from cultivated ground. It is called "Bánserai" in the North-Western Provinces.

Sphæranthus indicus, L. Gnaphalium luteo-album, L.—Aravalli hills.

Cæsulia axillaris, Roxb.—Common in or near water.

Vicoa auriculata, Cass.—Rocks; common.

Pulicaria crispa, Benth.—Sandy ground; common.

Eclipta alba, Haskk.—A common weed.

Sclerocarpus africanus, Jacq.—Common.

Verbesina encelioides, B. & Hk. f.—An American introduction, which is becoming naturalized in many parts of Upper India.

Glossocardia linearifolia, Cass.—A small glabrous herb, found at Bhim, in Merwára.

Cotula anthemoides, L.—Common, especially near water.

Echinops echinatus, DC.—Common.

Dicoma tomentosa, Cass.—Dry rocky ground; common.

Launæa nudicaulis, Less.—A common weed on waste ground

Plumbagineæ—

Plumbago zeylanica, L.—Glandular under-shrub in bushy places, flowers white.

Vogelia indica, Gibs.—Vern. "chetul." A small shrub, with thick greyish amplexicaul leaves and brownish-red flowers. Common in Merwára.

Primulaceæ—

Anagallis arvensis, L., var. *cærulea*.—A cold-weather annual weed.

Sapotaceæ—

Bassia latifolia, *Roxb.*—Vern. "mahwa." Becoming naturalized in Rájputána; the growth of this useful tree should be encouraged.

Ebenaceæ—

Diospyros tomentosa, *Roxb.*—Vern. "timru," "tíbru" (Merwára); "tendu" (North-Western India). This is the ebony (*Abnus*) of Upper India, not common in Merwára, and always more or less stunted. Fruits eaten.

D. montana, *Roxb.* (K.)—A medium-sized tree. The wood is very handsome, and the foliage is used as fodder.

Oleaceæ—

Jasminum humile, *L.* (K.)—A small shrub, with yellow flowers, abundant on Mount Abu, but doubtfully indigenous.

J. officinale, *L.*—Aravalli hills, above Bhim.

Schrebera swieteniqides, *Roxb.*—Vern. "mokha." A medium-sized tree, not common in Merwára.

Salvadoraceæ—

Salvadora persica, *L.*—Vern. "charli jál." A small evergreen tree; the foliage is a favourite fodder of camels. Suitable for roadsides on a saline soil.

Apocynaceæ—

Carissa Carandas, *L.* (K.)—Vern. "karaunda." A prickly shrub with highly-scented white flowers. It is abundant on Mount Abu.

Nerium odorum, *Soland.* (K.)—Probably introduced in Rájputána.

Wrightia tinctoria, *Br.*—Vern. "khirni." A common tree on the Merwára hills, conspicuous during the cold season by its long cylindrical pods, in pairs. It has white close-grained wood, which is much used for carving.

Asclepiadaceæ—

Periploca aphylla, *Dène.* (K.)—A shrub, with small sweet-scented purple flowers.

Cryptolepis sp.—Forest near Todgarh. Specimens were gathered in leaf only.

Calotropis gigantea, R. Br.—Common in Merwára.

Dæmia extensa, R. Br.—Vern. "menda singh." Bushy places common.

Marsdenia sp.—Aravalli hills near Ákhajitgarh.

Orthanthera viminea, W. & A.—A leafless shrub, with smooth, erect, virgate branches. Common on sandy ground.

Gentianaceæ—

Enicostema littorale, Blume.—Merwára. (*A. E. Lowrie.*)

Canscora diffusa, R. Br.—Abundant beside a stream in a forest near Todgarh, in company with *Cyathocline lyrata* and *Adiantum Capillus-Veneris*.

Borragineæ—

Cordia Myxa, L.—Vern. "bara gund," "lasora." Forest, Merwára. Mr. Lowrie pointed out to me a very distinct variety of this with narrow leaves. It is not uncommon in Merwára and is called "Gundi."

C. Rothii, R. & S.—Vern. "gundi" or "gondi." A small tree, with narrow linear leaves. Fruit edible. Rocky ground in Merwára.

C. Macleodii, Hk. f. & T.—Vern. "godela." A handsome tree with large leaves, their undersides densely tomentose; not common in Rájputána.

Ehretia lævis, Roxb.—Vern. "tambolia" Merwára. (*A. E. Lowrie.*)

Heliotropium zeylanicum, Lamk.—Merwára.

H. supinum, Linn.—Common on sandy ground.

H. Eichwaldi, Steud.—Merwára (*A. E. Lowrie.*).

H. strigosum, Willd.—A common weed on waste ground.

H. rariflorum, Stocks?—Dry hills, Ajmir.

Trichodesma indicum, R. Br.—Common.

Arnebia hispidissima, DC.—A small hispid weed, with bright yellow flowers.

Convolvulaceæ—

Rivea hypocrateriformis, Chois.—A twining shrub, with large white flowers. Common in bushy places.

Ipomæa pes-tigridis, Linn.—Merwára. (*A. E. Lowrie.*)

I. aquatica, Forsk.—Merwára. (*A. E. Lowrie.*) Other species were collected, but have not yet been identified.

Convolvulus arvensis, L. (K.)
C pluricaulis, Chois. (K.)—Sandy soil.
Evolvulus alsinoides, Linn.—Merwára; common.
Cressa cretica, L. (K.)
Cuscuta reflexa. Roxb.

Solanaceæ—

Solanum xanthocarpum, Schrad. & Wendl.—Roadsides and waste places. A prickly herb, with purple flowers and orange-coloured fruit.
S. nigrum, L.—Merwára; common.
S. coagulans, Forsk.—Todgarh, Merwára.
Physalis minima, L.—Merwára. (*A. E. Lowrie.*)
Withania somnifera, Duval.—Vern. "asind." Merwára, common.
Lycium europæum, L.—Vern. "achmehndi." Merwára.
Datura sp.—Vern. "dhatura." Merwára.

Scrophularineæ—

Celsia coromandeliana, Vahl.—Merwára.
Lindenbergia urticæfolia, Lehm.—Walls and rock crevices; common.
Limnophila racemosa, Benth.—Merwára; in water.
L. gratioloides, R. Br.—Merwára, near water.
Veronica Anagallis, L.—Merwára; edges of streams; common.

Orobanchaceæ—

Cistanche tubulosa, Wight.—Vern. "chumphor." Rampura, near Ajmir. (*A. E. Lowrie.*) Parasitical on the roots of *Calotropis procera.*

Lentibularieæ—

Utricularia stellaris, L. (K.)

Bignoniaceæ—

Tecoma undulata, G. Don.—Vern. "rohira." A small tree, with handsome orange-coloured flowers; common on the dry hills of Merwára.

Pedalineæ—

Martynia diandra, Glox.—Tiger or Devil's Claw An introduction from America, and becoming naturalized over a large part of India.

Acanthaceæ—

Elytraria crenata, Vahl.—Merwára. (*A. E. Lowrie.*)
Blepharis boerhaaviæfolia, Pers.—Merwára. (*A. E. Lowrie.*)
Barleria Prionitis, L.—Merwára. Common.
B. cristata, L.—Todgarh, Merwára. (*A. E. Lowrie.*)
Andrographis echioides, Nees.—Aravalli hills.
Lepidagathis Hamiltoniana, Wall.—Dry hills of Merwára. A remarkable-looking plant, with the flowers and spiny bracts congested into globular heads.
L. trinervis, Nees.—A small, very prickly shrub, common on the Merwára hills.
Justicia diffusa, Willd.—Aravalli hills.
J. simplex, Don.—Common.
Peristrophe bicalyculata, Nees.—Vern. "káli andi jahria." Merwára.

Verbenaceæ—

Lantana sp.—Merwára.
Lippia nodiflora, Rich.—Common on wet ground.
Gmelina arborea, L.—Vern. "sewan." A medium-sized tree, with brownish-yellow flowers. Merwára. (*A. E. Lowrie.*)
Vitex trifolia, L. f.—A shrub or small tree, with ash-coloured foliage, and lavender-blue flowers. Found in beds of streams in Merwára.
Clerodendron phlomoides, L. f.—A tall shrub, with fragrant white flowers.

Labiatæ—

Ocimum basilicum, L.—Merwára.
Salvia plebeia, Br. (K.)
Leucas urticæfolia, R. Br.—Vern. "mohdar ka patta." Merwára.
L. Cephalotes, Spreng.—A common weed in cultivated ground.
Leonotis nepetæfolia, R. Br.—Vern. Mawa bir, Ajmir. (*A. E. Lowrie.*)

Nyctagineæ—

Boerhaavia verticillata, Poir.—Vern. "sátha" or "sáthi." Merwára. Common.

Amarantaceæ—

Celosia argentea, L.—Waste and cultivated ground, generally near habitations.

Digera arvensis, Forsk.—Merwára. (*A. E. Lowrie.*)
Amarantus gangeticus, L.—Vern. "chandalor" or "labra." Cultivated ground. Merwára.
Pupalia lappacea, Moq.—Common.
Nothosæra brachiata, Wight.—Merwára. (*A. E. Lowrie.*)
Aerua javanica, Juss.—Vern. "chin." A shrubby tomentose plant, with densely woolly flower-spikes. Common in Merwára.
Achyranthes aspera, L. (K).
Alternanthera sessilis, R. Br.—Common in Merwára.

Chenopodiaceæ—

Suæda spp.—On saline soil in Merwára.
Chenopodium album, L.—Vern. "chel." Cultivated ground, Merwára.
Anabasis multiflora, Moq. (K)—On saline soil.

Polygonaceæ—

Polygonum Roxburghii (K.), and two other species from Merwára, not determined.
Rumex sp.—Merwára; common.

Aristolochiaceæ—

Aristolochia bracteata.—Ajmir. (*A. E. Lowrie.*)

Loranthaceæ—

Loranthus longiflorus, Desr.—Parasitical on *Boswellia serrata*, Aravalli hills.

Euphorbiaceæ.—

Euphorbia Nivulia, Ham.—Vern. "tor." A shrubby species, with round succulent spiny stems, common about Ajmir, and on the Aravalli hills in Merwára. Is much used for hedges. In unreserved tracts protection is naturally afforded by clumps of this *Euphorbia* to a variety of plants, including seedling trees, which would otherwise be destroyed by cattle and goats.
E. neriifolia, L. (K).
Mallotus philippinensis, Müll.—Vern. "senduria" (Merwára). Found at Dewair in Southern Merwára by Dr. Brandis, and by Dr. King at Mount Abu. This is the "Kamela" tree of Northern India.
Ricinus communis, L.—Castor-oil plant. Vern "edia arend" (Mer-

wára). Becoming naturalized. It is indigenous in Northern Africa.

Securinega Leucopyrus, Müll.—Vern. "salepan," "halepan." These names are applied also to another species found in Merwára, *viz.*, *S. obovata*, which differs in being less spiny. I have specimens of the former from Barár in Merwára.

Briedelia retusa, Spreng.—Vern. "lamkana." Forest near Todgarh, Merwára.

Phyllanthus Emblica, L.—Vern. "aonla."

P. reticulatus, Poir.—Vern. "kabonan." A climbing shrub.

Urticaceæ—

Ulmus integrifolia, Roxb.—Vern. "charbi" (Merwára). Dr. Brandis also gives the following: "cherril," "surril," "chirlia," "sirlia." Not uncommon in Merwára in the valleys, and frequently planted near villages.

Sponia politoria, Planch.—Merwára. (*A. E. Lowrie.*)

Ficus Tsiela, Roxb.—Ajmir. (*A. E. Lowrie.*)

F. virgata, Roxb.—Vern. "kembri." Mostly near villages, fruit edible.

F. cordifolia, Roxb.—Vern. "paras pipal." Found only in a dwarfed state in Rájputána. A large handsome tree when full-grown. Three other kinds of fig are found, but they are not indigenous, *viz.*, the "bar" or "banyan" (*F. bengalensis*), the "pipal" (*F. religiosa*), and the "gular" (*F. glomerata*)

Girardinia heterophylla, Dcne. (K.)—Mount Abu.

Hydrocharideæ—

Hydrilla ovalifolia, Roxb.—In water, Merwára.

Vallisneria spiralis, L.—In water, common in Merwára.

Ottelia alismoides, Pers.—In water; common.

Orchideæ—

Aerides sp. (K.)—Mount Abu.

Zeuxine sulcata, Lindl.—Forest near Todgarh.

Liliaceæ—

Asparagus racemosa, Willd.—Ajmir. (*A. E. Lowrie.*)

A. sp.—Vern. "nár kánta." Near Bhim, in Merwára.

Asphodelus fistulosus, L. (K.)—Cultivated ground.

Gloriosa superba, L.—Vern. "rájah ráf," Ajmir. (*A. E. Lowrie.*) I saw specimens also in a forest near Bhim.

Commelinaceæ—

Commelina sp.—Merwára. (*A. E. Lowrie.*)

Junceæ—

Juncus articulatus, L.—Edges of tanks in Merwára.

Typhaceæ—

Typha sp.—Merwára. (*A. E. Lowrie.*)

Lemnaceæ—

Lemna sp.—Merwára, in pools; common.

Alismaceæ—

Butomopsis sp.—Merwára. (*A. E. Lowrie.*)

Naiadaceæ—

Potamogeton pectinatus, L.—Common in tanks.
P. natans, L.—Tanks and streams, Merwára.

Cyperaceæ—

Cyperus niveus, Retz.—Vern. "gondla."
C. pygmæus, Rottb.—Bed of old tank, Jodhpur. (*A. E. Lowrie*)
C. difformis, L.—Blúm, Merwára. Other species of *Cyperus* were seen, but were not in a condition for proper identification.
Fimbristylis dichotoma, Vahl.—Vern. "gondla."
Scirpus quinquefarius, Buch. Ham.—Common on wet ground.
S. subulatus, Vahl.—Vern. "gundela," Barár tank, Merwára.
S. grossus, L. (K).—Mount Abu.

Gramineæ—

Paspalum scrobiculatum, L., var. *Kora.*—Vern. "chinke" (Merwára). A common grass near water. Good for fodder.
Panicum colonum, L.—Vern. Sáwán. (Udaipur.) Common at Ajmir and in Merwára. An excellent fodder grass, the sánwak of North-Western India.
P. Crus-galli, L.—Sáma (Merwára); "shálbut" (Udaipur). Resembles the preceding, but more robust; usually found in or near water. The grain is eaten, and bread is made of it in Merwára.
P. flavidum, Retz.—Vern, "cheeda sáwán" (Udaipur). Common. Called "barú" in the North-West, and reckoned a good fodder grass.

Panicum, fluitans, Retz.—Common on damp ground and by streams, often growing in water. Called "hal" at Udaipur

P. helopus, Trin.—I have specimens from Ajmir, collected by Mr. Lowrie. It is a good fodder grass, and is called "kuri" in North-Western India.

P. Petiverii, Trin.—Barár, in Merwára.

P. sanguinale, L.—Common. This is the "takriya" of North-Western India. It is a good fodder grass. It is highly esteemed also in America, where it is called "crab-grass." A variety with the edges of the glumes ciliate is also common in Merwára.

P. (Tricholæna) Wightii.—Vern. "karr" (Merwára); "jhumráli" (Udaipur). I have specimens collected by Mr. Lowrie at Ajmir and in Merwára, and from Mr. A. Wingate at Udaipur.

Setaria glauca, Beauv.—Vern. "soma" (Merwára); "kharkhura" (Udaipur). Called "bandra" in the North-West, where it is used as fodder.

S. intermedia, R. & S.—Ajmir. (*Lowrie.*)

S. verticillata, Beauv.—Vern. "bandri" (Merwára); "sársata" (Udaipur). Eaten by cattle when young. Called "chirchitta" in North-Western India.

Cenchrus montanus, Nees.—Vern. "dhámun." Common in Merwára. Used as fodder. I have a specimen from Udaipur named "bhurt," but the true "bhurt" is *C. catharticus*, a very prickly kind.

Pennisetum cenchroides, Rich.—A valuable fodder grass. Common all over North-Western India, and called "anjan" or "dhámun."

P. imberbe, Edgew.—Vern. "bhajrya chota" (Udaipur).

Coix Lachryma, L.—An aquatic grass, with large pearly white grains.

Tragus racemosus, Hall.—A small but nutritious grass, common on sandy ground. Called "dhámun" in Merwára.

Perotis latifolia, Ait.—Ajmir. (*Lowrie*).

Saccharum Sara, Roxb.—Vern. "sarpat," Ajmir. (*Lowrie.*) A tall, handsome grass, resembling "munj," but the flowers are in a closer and more contracted panicle.

S. spontaneum, L.—Vern. "káns" (Udaipur).

S. Nareya, Benth.—Vern. "panni." Forest west of Bár, Merwára.

Pollinia tristachya.—Vern. "gomti" (Udaipur).

Arthraxon echinatum, Nees.—Vern. "undári" (Merwára) "dundri" Udaipur).

Rottbœllia exaltata, L. F.—Vern. "bhariali" (Udaipur).

A. molle.—Forest near Todgarh.

Ischæmum laxum, R. Br.—Vern. "seran" or "hirn" (Ajmir). I gathered specimens of this on the Aravalli hills in Merwára. Mr. Lowrie tells me that this grass is considered at Ajmir to be one of the best for fodder purposes during the month of October. I have specimens also from Udaipur: *I. rugosum, Salisb.*—Vern. "toli" (Udaipur).

Heteropogon contortus, R. & S.—(Spear grass.)—Vern. "sarwála." This grass is largely used in Rájputána for fodder. It is cut and stored for future use in small stacks, which are to be seen at nearly every village in certain parts of Merwára. These stacks are composed of three different kinds of grass. The lower and larger portion consists of "sarwála;" this is overlaid with layers of "Chángta" (*Apluda aristata*) and on the top of all, and forming the roof of each stack, are sheaves of the sweet-scented "Roaunshra" (*Andropogon Schœnanthus*),

H. hirtus, Pers.—Vern. "kuta" (Udaipur.)

Andropogon Bladhii, Retz.—Vern. "khar." Common. Flowers all through the cold season. In North-Western India it is called "palwál" or "palwán," a name applied by natives to other species of *Andropogon*. It is considered to be a good fodder grass.

A. foveolatus, Del.—Vern. "bohára" (Udaipur). Used as fodder, but very little is known as to quality. It is often found in a stunted condition in rock crevices, but will grow luxuriantly under favourable conditions.

A. laniger, Desf.—Vern. "runa" (Merwára). This is one of the sweet-scented grasses, allied to and resembling *A. Schœnanthus*, but with more woolly inflorescence and much narrower leaves. It is highly valued as a fodder grass in the Punjab.

A. muricatus, Retz.—Vern. "gándar," Merwára. This is the "panni" of North-Western India, the roots, "khas-khas," affording the chief material for tatties. The "panni" of Merwára is a species of Saccharum. It is good for fodder when quite young.

A. pertusus, Willd.—A common grass, flowering during the rainy season. Valued highly for fodder in North-Western India under the name of "palwál."

A. Schœnanthus, L.—Vern. "roaunshra" (Merwára); "rauns" (Punjáb). Abundant in Rájputána, and largely used as fodder. The whole plant is strongly scented. It turns bright red after the rains are over, and shows conspicuously in the stacks of which it usually forms the roofing material.

A. strictus, Roxb.—Vern. "boári," "junjli" (Merwára). A tall

wiry grass, resembling *A. foveolatus*. It is abundant in some of the reserves where it is cut as fodder.

Sorghum halepense, Pers.—Vern. "bowári" (Merwára). This is the "baru" of North-Western India. A tall handsome grass allied to "juár" (*Sorghum vulgare*). It affords excellent fodder, but is liable like "juár" to prove unwholesome to cattle, if eaten when too young, or when dwarfed during seasons of droughts. It is highly valued in America under the names of "Cuba" and "Johnson grass."

Anthistiria gigantea, Cav.—A tall, coarse grass. I have specimens from Ajmir collected by Mr. Lowrie.

A. Wightii.—Large "gurer rate" or "red bhera" (Udaipur). I have specimens from Udaipur and from Gwalior, which I believe belong to this species. At Gwalior it appears to be largely used for fodder.

Apluda aristata, L.—Vern. "chángta" (Merwára). Very common, especially in some of the forest reserves. In the "Dhaukra" forest near Todgarh, it forms the main portion of the undergrowth. It is used for fodder.

Aristida depressa, Retz.—A good fodder grass. Common on sandy ground. Called "lamb" in the Punjab.

A. murina, Cav.—A slender feathery grass, resembling the preceding and growing on similar soil. Called "lámp" in the Punjab, and used for fodder.

Sporobolus tenacissimus, Beauv.—Vern. "cherria" or "khar." Common on saline soil. This is the "usar ki ghás" of North-Western India. I have unidentified specimens of other kinds of *Sporobolus* collected near Ajmir by Mr. Lowrie.

Polypogon monspeliensis, Desf.—Vern. "chitra" (Ajmir). I have specimens collected by Mr. Lowrie.

Cynodon Dactylon, Pers.—Vern. "dub." Common.

Chloris digitata, Steud.—Todgarh (Merwára).

C. tenella, Roxb.—Vern. "morbhaga" (Udaipur). I have specimens also from Ajmir, collected by Mr. Lowrie.

Melanocenchris Royleana, Nees.—A pretty little feathery grass, common on sandy soil.

Tetrapogon villosus, Desf.—Vern. "pungi" (Merwára).

Eleusine ægyptiaca, Pers.—Vern. "maligha" (Udaipur). Common in Merwára. This is the "makra" of North-Western India. It is a good fodder grass.

E. calycina, Roxb. Syn. *Leptochloa arabica, Kunth.*—Vern. "kharghás" (Udaipur). I have specimens collected in Merwára by Mr. Lowrie.

E. flagellifera, Nees.—A slender species somewhat resembling

and usually replacing "dub" on sandy soil. It affords good fodder.

Eleusine indica, Gærtn.—A coarse grass; common on waste ground.

E. scindica, Duthie. Syn. *Dactyloctenium scindicum, Boiss.*—A slender grass, resembling small specimens of "makra," but much more graceful. Always on sandy soil. It is called "bhobra" in the Punjab.

E. verticillata, Roxb.—Vern. "kuri chinke" (Ajmir). Of no great value for fodder.

Elytrophorus articulatus, Beauv.—Not common. I have specimens from Merwára, collected by Mr. Lowrie.

Eragrostis bifaria, W. & A.—A small, hard, wiry grass, common on the Aravalli hills.

E. ciliaris, Link.—Plentiful on sandy soil and frequently on usar, accompanying *Sporobolus tenacissimus*. A nutritious grass, but too small to be of much account.

Var. *brachystachya.*—Vern. "chim" (Merwára); "baram jari" (Udaipur). Common on dry sandy ground. Differs from the preceding by its dense, spike-like panicles.

E. cynosuroides, Retz.—A coarse grass known as "dáb" in Upper India. Often found on usar land, its strong roots enabling it to obtain its nourishment from less saline portions of the soil. Buffaloes appear to like this grass when young.

E. elegantula, Nees.—Vern. "jarhi dúb" (Udaipur).

E. megastachya, Link.—Merwára; common. Foliage too scanty to yield much fodder.

E. nutans, Boiss.—Vern. "ganda." Merwára.

E. poæoides, Beauv.—I have specimens from Ajmir, collected by Mr. Lowrie.

Oropetium Thomaum, Trin.—A very diminutive little grass, not uncommon in Merwára, where it forms a considerable part of the turf on depressed portions of sandy ground.

Dendrocalamus strictus, Nees.—Clumps of this common Indian bamboo are occasionally met with on the Aravalli hills.

Filices—

Adiantum lunulatum, Burm. (K).—On Mount Abu.

A. caudatum, L.—Shady rocks in Merwára; common.

A. Capillus-Veneris, L.—Not uncommon in Merwára, in damp shady situations.

Cheilanthus albo-marginata, C. B. Clarke.—Rock crevices; common.

Actiniopteris dichotoma, Bedd.—Abundant in rock crevices.

Nephrodium parasiticum, C. B. Clarke. (K.)—Mount Abu.

Nephrodium cicutarium, Hk. & Bak. (K.)—Mount Abu.

Botrychium virginianum, Swartz. (K.)—Mount Abu; rare.

The following species, mostly trees, are also to be found in Rájputána, but they are introductions:—

Michelia Champaca, L. (N. O. MAGNOLIACEÆ.)—The "Champak tree." Planted at Mount Abu (K.) A handsome tree, well known for its sweet-scented flowers. The tree, being held sacred by Hindus, is usually to be found in the vicinity of temples.

Anona squamosa, L. (K.) (N. O. ANONACEÆ.)—Vern. "sharifa," called Custard-apple in India.

Ailanthus excelsa, Roxb. (N. O. SIMARUBEÆ.)—Vern. "arua." Thrives well on sandy soil. (*Brandis.*)

Melia indica, Brandis.—(N. O. MELACEÆ.)—Vern. "nim." This valuable timber tree thrives well in Merwára, and is easily propagated.

Melia Azedarach, L. (N. O. MELIACEÆ.)—Persian Lilac. Vern "bakain."

Zizyphus Jujuba, Lamk. (N.O. RHAMNEÆ.)—Vern. "ber." Thrives well in Merwára, and should be encouraged for the sake of its fruit, which is capable of much improvement by cultivation.

Mangifera indica, L. (N. O. ANACARDIACEÆ.)—"The Mango." Dr. King says is the "prevailing tree on the slopes of Abu. It is doubtfully indigenous, and was probably originally introduced by the numerous pilgrims who have for ages frequented the sacred shrines for which the mountain is famous."

Dalbergia Sissoo, Roxb. (N. O. LEGUMINOSÆ.)—Vern. "sissu." The climate of Merwára is too dry to allow of any extensive plantings of this valuable timber tree.

Pongamia glabra, Vent. (N. O. LEGUMINOSÆ.)—Vern. "kurrus," "karija," "sarlia," or "chera." A handsome, almost evergreen tree, suitable for planting along roadsides. It thrives remarkably well in Merwára.

Poinciana elata, L. (N. O. LEGUMINOSÆ.)—Cultivated near villages. It has been recommended for planting on saline soils, and the foliage is said to afford excellent fodder.

Parkinsonia aculeata, L. (N. O. LEGUMINOSÆ.)—*Vide* preceding list.

Tamarindus indica, L. (N. O. LEGUMINOSÆ.)—Vern. "amli."

Acacia farnesiana, Willd. (N. O. LEGUMINOSÆ.)—A thorny shrub introduced from America, very like the babúl when in flower, and hence its name, "vilayati kikar"

Acacia arabica, Willd.—*Vide* preceding list.

Albizzia Lebbek, Benth. (N. O. LEGUMINOSÆ).—Vern. "siris."

Prunus persica, Benth & Hk. f. (N. O. ROSACEÆ.)—The Peach tree. Vern, "aru."

Psidium Guyava, L. (N. O. MYRTACEÆ.)—The Guava tree. Vern. "amrut."

Punica Granatum, L. (N. O. LYTHRACEÆ.)—The Pomegranate. Vern. "anar."

Opuntia Dillenii, Haworth. (N. O. CACTEÆ.)—*Vide* preceding list.

Verbesina encelioides, B. & Hk. f. (N. O. COMPOSITÆ.)—*Vide* preceding list.

Mimusops indica, A. DC. (N. O. SAPOTACEÆ.)—Vern. "khirni."

M. Elengi, L.—Vern. "mulsári."

Jasminum humile, L. (N. O. OLEACEÆ.)—*Vide* preceding list.

Nerium odorum, Soland. (N. O. APOCYNACEÆ.)—*Vide* preceding list.

Martynia diandra, Glox. (N. O. PEDALINEÆ.)—*Vide* preceding list.

Ricinus communis, L. (N. O. EUPHORBIACEÆ.)—*Vide* preceding list.

Ficus bengalensis, L. (N. O. URTICACEÆ.)—The Banyan tree. Vern. "bargat."

F. religiosa, L.—Vern. "pipal."

F. glomerata, Roxb.—Vern. "gular."

Morus alba, L. (K.)—Mulberry. Vern. "tut."

Government of India Central Printing Office.—No. 25 R. & A.—18-9-86.—410.

IV. Extracts from Official Gazettes.

1.—Gazette of India—

No. 384.—*The 13th May, 1886.*—*Mr. M. Muttannah*, Sub-Assistant Conservator of Forests in Coorg, is appointed to officiate, until further orders, as an Assistant Conservator of Forests of the 3rd grade, with effect from the 1st April, 1886

No. 416.—*The 20th May, 1886.*—*Mr. A. Watson*, officiating Assistant Conservator of Forests of the 3rd grade, in the Central Provinces, is appointed substantively *pro tempore* to be an Assistant Conservator of the 3rd grade, with effect from the 14th January, 1886.

No. 431.—*The 27th May, 1886.*—With reference to the Notification of this Department, No. 316F., dated the 22nd ultimo, *Mr. A. E. Broun*, officiating Deputy Conservator of Forests of the 4th grade, in the North-Western Provinces and Oudh, is appointed to officiate as Deputy Director of the Forest School at Dehra Dún during the absence of *Mr. E. E. Fernandez*, on special duty in connection with the preparation of Working-Plans of Forests.

2.—Calcutta Gazette—

The 4th June, 1886.—*Babu Shama Churn Chuckerbutty*, Forest Ranger, officiating Sub-Assistant Conservator of Forests, 3rd grade, is confirmed in his appointment, with effect from the 1st June, 1886, and will remain in charge of the Angul Sub-division of the Orissa Forest Division.

The 24th June, 1886.—Consequent on the retirement from the service of *Mr. G. W. Strettell*, Deputy Conservator of Forests, 1st grade, with effect from the 11th November, 1885, the following promotions are made:—

Mr. E. G. Chester, Deputy Conservator of Forests, 3rd grade, sub. *pro tem.*, is confirmed in that grade, with effect from the 25th September, 1884.

Mr. F. B. Manson, officiating Deputy Conservator of Forests, 3rd grade, is appointed to that grade, sub. *pro tem.*, with effect from 11th November, 1885.

Mr. W. Johnston, officiating Deputy Conservator of Forests, 4th grade, is confirmed in that grade, with effect from 11th November, 1885.

The 24th June, 1886.—Consequent on the retirement from the service of *Mr. D. E. Hutchins*, Deputy Conservator of Forests, 3rd grade, with effect from the 1st January, 1886, the following promotions are made:—

Mr. F. B. Manson, Deputy Conservator of Forests, 3rd grade, sub. *pro tem.*, is confirmed in that grade, with effect from 11th November, 1885.

Mr. C. A. G. Lillingston; officiating Deputy Conservator of Forests, 4th grade, is confirmed in that grade, with effect from 1st January, 1886.

Mr. R. L. Heinig, officiating Assistant Conservator of Forests, 1st grade, is confirmed in that grade, with effect from 1st January, 1886.

3.—North-Western Provinces and Oudh Gazette—

No. $\frac{2191}{448\text{-}3\text{-}12}$.—*The 4th June, 1886.—Mr. G. Greig*, Conservator of Forests, Central Circle, North-Western Provinces and Oudh, furlough for two years, with effect from the 22nd June, 1886, or subsequent date.

No. $\frac{2287}{II\text{-}448\text{-}14\text{-}2}$.—*The 10th June, 1886.—Mr. N. Hearle*, officiating Deputy Conservator of Forests, 4th grade, on special duty in the Central Circle, privilege leave for three months, with effect from the 20th June, 1886, or subsequent date.

No. $\frac{2252}{II\text{-}448\text{-}15\text{-}2}$.—*The 15th June, 1886.—Mr. W. R. J. Brereton*, Deputy Conservator of Forests, 1st grade, in charge Ganges Forest Division, privilege leave for two months and twenty days, with effect from the 20th June, 1886, or subsequent date.

4.—Punjab Gazette—

No. 221.—*The 21st May, 1886.—Mr. W. Shakespear*, Deputy Conservator of Forests, Rawalpindi Division, is granted three months' privilege leave of absence with effect from the 1st of May, 1886.

No. 222.—*Mr. J. L. Pigot*, Assistant Conservator of Forests, received over charge of the Rawalpindi Division from *Mr. W. Shakespear*, on the afternoon of the 30th April, 1886.

No. 249.—*The 10th June, 1886.—Mr. E. A. Down*, Deputy Conservator of Forests, on being relieved of the charge of the Phillour Division on the afternoon of the 17th April, 1886, was transferred to the Kulu Division, of which he received charge on the afternoon of the 3rd May, 1886.

No. 251.—*Mr. F. O. Lemarchand*, Deputy Conservator of Forests, on being relieved of the charge of the Kulu Division, on the afternoon of the 3rd May, 1886, was transferred to the Kangra Division, of which he received charge on the forenoon of the 10th idem.

No. 253.—*Colonel W. Stenhouse*, Deputy Conservator of Forests, on being relieved of the charge of the Kangra Division, on the forenoon of the 10th May, 1886, was transferred to the Phillour Division, of which he received charge on the afternoon of the 15th idem.

No. 255.—*Mr. E. S. Carr*, Assistant Conservator of Forests, on being relieved of the charge of the Phillour Division on the afternoon of the 15th May, 1886, is attached to the office of the Conservator of Forests, Punjab, which he joined on the forenoon of the 17th idem.

No. 257.—*The 11th June, 1886.*—*Mr. J. Copeland*, Assistant Conservator of Forests, in charge of the Chenab Division, is granted privilege leave of absence for three months with effect from the forenoon of the 29th May, 1886.

No. 258.—*Mr. A. L. McInture*, Assistant Conservator of Forests, received charge of the Chenab Division, on the afternoon of the 28th May, 1886, relieving *Mr. J. Copeland*, proceeding on leave.

5.—CENTRAL PROVINCES GAZETTE—

No. 2686.—*The 19th June, 1886.*—*Mr. A. Watson*, Assistant Conservator of Forests, 3rd grade, sub. *pro tem.*, is promoted to the 2nd grade of Assistant Conservators, sub. *pro tem.*, with effect from the 14th January, 1886.

6.—BRITISH BURMA GAZETTE—

No. 343.—At the Departmental examinations held at Rangoon on the 7th and 8th June, 1886, the undermentioned candidate passed the examination in Burmese by the Lower Standard :—

Mr. H. A. Hoghton, Assistant Conservator of Forests.

7.—ASSAM GAZETTE—

No. 215.—*The 12th June, 1886.*—Privilege leave of absence for three months, under Sections 71-74, Chapter V. of the Civil Leave Code, is granted to *Mr. F. S. Barker*, Assistant Conservator of Forests, with effect from the 4th July, 1886.

No. 216.—*Mr. C. G. D. Fordyce*, Assistant Conservator of Forests, Sibságar Division, is placed in charge of the Lakhimpur Division, in addition to his own duties, during the absence of *Mr. Barker.*

8.—MYSORE GAZETTE—

Nil.

9.—MADRAS GAZETTE—

The 23rd May, 1886.—In continuation of office order, No. 30, of 10th May, 1886, *B. Guru Row*, Forester, Rayachoti Range, is transferred to Badvel Range and appointed to act as Forest Ranger, 5th grade, until the return of *P. Srinivasa Row.*

Mr. C. L. Toussaint, Sub-Assistant Conservator, will take charge of the Rayachoti Range in addition to his own duties.

The 24th May, 1886.—The following promotions are ordered in the subordinate staff of the Northern Division with effect from the 1st June, 1886 :—

Mr. H. H. Ward, Forest Ranger, 2nd grade, to act as Forest Ranger, 1st grade.

Mr. W. R. Newman, Forest Ranger, 3rd grade, to act as Forest Ranger, 2nd grade.

Mr. T. G. A. Gaudoin, Forest Ranger, 3rd grade, to act as Forest Ranger, 2nd grade.

T. M. Nallasawmy Naidu, Forest Ranger, 4th grade, to act as Forest Ranger, 3rd grade.

In modification of office order, No. 8, of 7th April, 1886, *Mr. James Fullerton*, is appointed to be Forest Ranger, 5th grade, on probation with effect from 1st April, 1886.

The 28th May, 1886.—Forester, 4th grade, *Alagiriswami Nayudu*, to act as Ranger, 5th grade, from the 19th of May, 1886, during the absence of *Maria Pillay* on privilege leave.

The 10th June, 1886.—*Mr. S. A Newnan*, 2nd grade, Forest Ranger, acting 1st grade, North Arcot District, died on the 6th instant.

The 17th June, 1886.—*M. Shums-ud-din Sahib*, Acting Ranger, 4th grade, Coimbatore, South, is granted leave of absence for one month and ten days on medical certificate from 28th May, 1886, under section 128 of the Civil Leave Code.

No. 215.—*The 16th June, 1886.*—*Mr. A. W. B. Higgens*, District Forest Officer, Cuddapah, privilege leave for two months and seven days, from the 28th instant, under section 74 of the Civil Leave Code, Sixth Edition.

No. 222.—*Mr. A. W. C. Stanbrough*, Deputy Conservator of Forests, to act as District Forest Officer, Madura, during the absence of *Mr. Gass*, on furlough, or until further orders, without prejudice to his appointment as District Forest Officer, Trichinopoly.

No 223.—*Mr. H. J. A. Porter*, Assistant Conservator of Forests, 1st grade (acting Deputy Conservator of Forests, 4th grade), to act as Deputy Conservator, 3rd grade, *vice Mr. Gass.*

No. 224.—*Mr. A. W. Lushington*, Assistant Conservator of Forests, 1st grade, to act as Deputy Conservator, 4th grade, *vice Mr. Porter.*

The 24th June, 1886.—Promotions to have effect from 1st July—

N. Armuga Mudeliar, Forest Ranger, 3rd grade, Coimbatore, South, to act in the 2nd grade.

A. Durgiah Nayudu, Forest Ranger, 4th grade, North Arcot District, to act in the 3rd grade.

T. Narayanaswami Aiyar, Ranger, 5th grade, to act in the 4th grade.

T. Venkatsubbaiyar, Forest Ranger, 3rd grade, South Arcot District, to the North Arcot District.

Mr. A. Srinivasa Chamberlain, Forest Ranger, 5th grade, (on probation,) doing duty in Central office, to South Arcot District.

10.—BOMBAY GAZETTE—

No. 3798.—*The 27th May, 1886.*—*Mr. H. Barrett*, Deputy Conservator of Forests, 1st grade, has been allowed by Her Majesty's Secretary of State for India an extension of furlough for 2 months.

Mr. G. A. Hight, Deputy Conservator of Forests, resumed charge of the Divisional Forest Office, Bijápur, from *Mr. J. M. Fernandez* Sub-Assistant Conservator of Forests, on the 1st June, 1886, before office hours.

V. Extracts from Official Gazettes.

1.—Gazette of India—

No. 431.—*The 27th May, 1886.*—With reference to the Notification of this Department, No. 316F., dated the 22nd ultimo, *Mr. A. F. Broun*, officiating Deputy Conservator of Forests of the 4th grade in the North-Western Provinces and Oudh, is appointed to officiate as Deputy Director of the Forest School at Dehra Dún, during the absence of *Mr. E. E. Fernandez* on special duty in connection with the preparation of Working-Plans of Forests.

No. 513.—*The 19th June, 1886.*—Consequent on the grant of furlough to *Mr. G. Greig*, Conservator of Forests of the 1st grade, in charge of the Central Circle in the North-Western Provinces and Oudh, the following temporary promotions are made, with effect from the date on which *Mr. Greig* may avail himself of the leave in question :—

Captain E. S. Wood, Conservator of Forests, 2nd grade, Oudh Circle, North-Western Provinces and Oudh—to officiate in the 1st grade of Conservators.

Mr. A. L. Home, Conservator of Forests, 3rd grade, Bengal—to officiate in the 2nd grade of Conservators.

Mr. C. Bagshawe, Deputy Conservator of Forests, 2nd grade, North-Western Provinces and Oudh—to officiate in the 3rd grade of Conservators, and to have charge of the Central Circle in the North-Western Provinces and Oudh.

No. 534.—*The 24th June, 1886.*—*Mr. R. H. M. Elkis*, Deputy Conservator of Forests of the 2nd grade in Bengal, is appointed to officiate in the 1st grade of Deputy Conservators during the absence on privilege leave for two months and twenty days of *Mr. W. R. J. Brereton*, Deputy Conservator of the 1st grade in the North-Western Provinces and Oudh, with effect from the 20th June, 1886, or the subsequent date on which *Mr. Brereton* may avail himself of the leave in question.

2.—Madras Gazette—

The 30th June, 1886.—*Mr. C. L. Toussaint*, Sub-Assistant Conservator of Forests, 2nd grade, Cuddapah, will act in the 1st grade of Sub-Assistant Conservators while in charge of the District Forest Office, Cuddapah.

The 30th June, 1886.—*M. Subrayalu Nayudu*, Forester, 1st grade, South Arcot, to be Forest Ranger, 5th grade, on pro-

batioh, for one year from 1st July, and be posted to the same district.

Shams-ud-din Sahib, Forest Ranger, 5th (Acting 4th) grade, from Coimbatore (South) to Salem.

Vedamuttu Pillai, Forest Ranger, 5th grade, on probation, from South Arcot to Coimbatore (South).

3.—BOMBAY GAZETTE—

The 25th June, 1886.—*Mr. J. L. L. MacGregor*, Divisional Forest officer, Belgaum, and *Mr. J. M. Fernandez*, Sub-Assistant Conservator of Forests, respectively delivered over and received charge of the office of the Sub-Assistant Conservator of Forests, Belgaum, on the 19th June, 1886, before office hours.

4.—CALCUTTA GAZETTE—

Addendum.

The 15th July, 1886.—In supersession of that portion of the Notification of 24th June, 1886, published at page 772 of the *Calcutta Gazette* of the 30th June, 1886, that concerns *Mr. R. L. Heinig*—

Read

Consequent on the retirement from the service of *Mr. G. W. Strettell*, Deputy Conservator of Forests, 1st grade, with effect from 11th November, 1885, *Mr. R. L. Heinig*, Assistant Conservator of Forests, 2nd grade, is appointed to officiate as Assistant Conservator of Forests, 1st grade, from that date.

Consequent on the retirement from the service of *Mr. D. E. Hutchins*, Deputy Conservator of Forests, 3rd grade, with effect from 1st January, 1886, *Mr. R. L. Heinig*, Officiating Assistant Conservator of Forests, 1st grade, is confirmed in that grade, with effect from that date.

5.—NORTH-WESTERN PROVINCES AND OUDH GAZETTE—

No. $\frac{2608}{\text{II-448-3-24}}$.—*The 29th June, 1886.*—*Mr. S. E. Wilmot*, Deputy Conservator of Forests, Garhwál Division, to take charge of the Ganges Division, in addition to his other duties, during the absence on privilege leave of *Mr. W. R. J. Brereton*, or until further orders.

No. $\frac{2658}{\text{II-448-16-2}}$.—*The 30th June, 1886.*—*Mr. E. P. Dansey*, Deputy Conservator of Forests, in charge Bahraich Division, Oudh Circle, privilege leave for three months, with effect from the 25th July, 1886, or subsequent date.

No. $\frac{1463}{\text{VI-16-218-6}}$.—*The 10th July, 1886.*—In supersession of Notification No. 895A., dated the 16th July, 1877, and under section 14 of the Code of Criminal Procedure, *Mr. J. M.*

Braidwood, Assistant Conservator of Forests, is appointed a Special Magistrate and invested with the ordinary powers of a Magistrate of the 2nd class, to be exercised within the Naini Tal Forest Division in respect of offences punishable under Act VII. of 1878 (the Indian Forest Act).

6.—PUNJAB GAZETTE—

No. 292.—*The 8th July, 1886.*—In consequence of the absence on privilege leave, from 1st May, 1886, of *Mr. W. Shakespear*, Deputy Conservator of Forests, 3rd grade, the following temporary promotions are ordered with effect from the 31st idem:—

Mr. F. O. Lemarchand, Deputy Conservator, 4th grade, to officiate as Deputy Conservator, 3rd grade.

Mr. L. G. Smith, Assistant Conservator, 1st grade, to officiate as Deputy Conservator, 4th grade.

Mr. J. Copeland, Assistant Conservator, 2nd grade, to officiate as Assistant Conservator, 1st grade.

7.—CENTRAL PROVINCES GAZETTE—

No. 2869.—*The 2nd July, 1886.*—*Mr. F. C. Hicks*, Assistant Conservator of Forests, has passed the Departmental Examination in Land Revenue and Forest Law prescribed in Sections 50 and 51 of the Forest Code (3rd Edition).

8.—BURMA GAZETTE—

No. 255.—*The 23rd June, 1886.*—At the Departmental Examination of junior officers held at Moulmein on the 7th June, 1886, the undermentioned candidate passed the examination in Burmese by the Lower Standard:—

Mr G. H. Barnard, Assistant Conservator of Forests,—*with credit.*

No. 18.—*The 24th June, 1886.*—*Mr. H. A. Hoghton*, Assistant Conservator of Forests, 3rd grade, is promoted to be an Assistant Conservator of Forests, 2nd grade, with effect from the 8th June, 1886.

No. 19.—*The 7th July, 1886.*—*Mr. G. H. Barnard*, Assistant Conservator of Forests, 3rd grade, is promoted to be an Assistant Conservator of Forests, 2nd grade, with effect from the 7th June, 1886.

9.—ASSAM GAZETTE—

No. 256.—*The 8th July, 1886.*—*Mr. J. T. Jellicoe*, Officiating Deputy Conservator of Forests, 2nd grade, is confirmed in that appointment, with effect from the 11th November, 1885.

10.—MYSORE GAZETTE—

Nil.

V. Extracts from Official Gazettes.

1.—Gazette of India—

No. 585.—*The 12th July, 1886.*—*Mr. J. N. Pickard*, Deputy Conservator of Forests of the 4th grade in British Burma, is permitted to retire from the service, with effect from the 22nd May, 1886.

No. 604.—*The 23rd July, 1886.*—Consequent on the grant of furlough to *Captain E. S. Wood*, Conservator of Forests of the 2nd (officiating 1st) grade, in charge of the Oudh Circle in the North-Western Provinces and Oudh, the following temporary promotions are made, with effect from the 12th August, 1886, or the subsequent date on which *Captain Wood* may avail himself of the leave in question :—

Lieut.-Colonel G. J. van Someren, *M.G.L.I.*, Conservator of Forests of the 3rd (officiating 2nd) grade in Berar, to officiate in the 1st grade of Conservators.

Mr. H. C. Hill, Deputy Conservator of Forests of the 2nd grade in British Burma, and officiating Conservator of Forests of the 3rd grade in the Punjab, to officiate in the 2nd grade of Conservators.

Mr. R. H. C. Whittall, Deputy Conservator of Forests of the 3rd grade in the Central Provinces, and Assistant Inspector-General of Forests and Superintendent of Working-Plans, to officiate in the 3rd grade of Conservators, and to have charge of the Oudh Circle in the North-Western Provinces and Oudh.

No. 702.—*13th August, 1886.*—Consequent on the grant of privilege leave of absence for two months to *Mr. A. L. Home*, Conservator of Forests of the 3rd (officiating 2nd) grade in Bengal, the following temporary promotions are made :—

Mr. E. G. Chester, Deputy Conservator of Forests of the 3rd grade in Bengal, to officiate in the 3rd grade of Conservators, and to have charge of the Forest Department in Bengal, with effect from the 9th June, 1886.

Mr. H. C. Hill, Deputy Conservator of Forests of the 2nd grade in Burma, and officiating Conservator of Forests of the 3rd grade in the Punjab, to officiate in the 2nd grade of Conservators, with effect from the 21st June, 1886.

2.—Madras Gazette—

No. 271.—*The 21st July, 1886.*—*Mr. J. W. Cherry*, District Forest Officer, Salem, privilege leave for 2 months from or after the first proximo, under section 74 of the Civil Leave Code, Sixth Edition.

Mr. M. S. Noronha, First-class Certificate, Agricultural College, to be a Forest Ranger, 5th grade, on probation, and do duty in Trichinopoly till further orders.

No. 275.—*The 21st July, 1886.*—*Mr. Eber Hardie*, Sub-Assistant Conservator of Forests, Tinnevelly, will be considered to have acted as District Forest Officer of the same district during the absence of *Mr. Brasier* on privilege leave from 6th April, 1886.

No. 276.—*Mr. W. Carroll*, Sub-Assistant Conservator of Forests, 1st grade, to act as District Forest Officer, Salem, during the absence of *Mr. Cherry* on leave, or until further orders.

The 23rd July 1886.—*Mr. M. Callanan* is transferred from the Bellary District to the Cuddapah District—to join at once.

The 27th July, 1886.—*Mr. H. Kelly*, Postmaster, Kodaikanal, to act as a Forest Ranger, 5th grade, sub. *pro tem.*, on probation for six months from the 1st August, 1886, and do duty in the Madura District till further orders.

The 28th July, 1886.—*M. Shums-ud-din Sahib*, Ranger, 5th grade (acting 4th grade), Salem, six weeks' leave on medical certificate under section 128 of the Civil Leave Code, in extension of that already granted and notified in page 906, Part II. of *Fort St. George Gazette*, dated 18th June, 1886.

No. 289.—*The 30th July, 1886.*—*Mr. H. W. Ward*, Forest Ranger, 1st grade, Cuddapah, to be District Forest Officer, Kurnool.

The 4th August, 1886.—The following officers of the subordinate staff of the Northern Circle have passed the Departmental Test:—

1. *K. Strinivasam*, Forest Ranger, Kistna.
2. *Hari Row*, Forester, Nellore.
3. *Rama Row*, Clerk, Bellary.
4. *L. Hanumanthulu*, Forester, Bellary.
5. *Mr. Payrie*, Forester, Kurnool.
6. *D. Subbia Naidu*, Forester, Nellore.
7. *Venkatesa Mudaliar*, Forest Ranger, Nellore.
8. *Sunderappa*, Clerk, Vizagapatam.

No. 296.—*The 9th August, 1886.*—*Mr. C. G. Douglas*, Deputy Conservator of Forests, Madras, is granted 2 months' extension of sick leave by the Right Honorable the Secretary of State for India.

The 12th August, 1886.—The undermentioned officers have passed the examination set opposite to their names:—

V. S. Gurunadha Pillai, Sub-Assistant Conservator, 2nd grade (on probation), Coimbatore (South),	Departmental Test in Forest Code and Act.
Mr. S. Solomon, Acting Ranger, 5th grade, Tinnevelly District,	Departmental Test in Forestry and Accounts.
A. V. Chidambara Aiyar, Forester, 1st grade, South Arcot,	

3.—BOMBAY GAZETTE—

The 26th July, 1886.—*Messrs. A. Stewart* and *W. C. Rand* res-

pectively delivered over and received charge of the office of the Divisional Forest Officer, Ratnágiri, on the 17th instant, after office hours.

Messrs. R. S. F. Fagan and *H. Mainwaring*, Deputy Conservators of Forests, respectively delivered over and received charge of the office of the Divisional Forest Officer, Ahmednagar, on the 26th May, 1886, before office hours.

Messrs. G. S. Hinge, Acting Sub-Assistant Conservator of Forests, Sátára, and *G. K. Betham*, Divisional Forest Officer, Sátára, respectively delivered over and received charge of the office of the Sub-Assistant Conservator of Forests, Sátára, and Demarcation officer of the Bhor State on the 1st instant, before office hours.

Mr. L. B. Oka, after having delivered over charge of the office of the Sub-Assistant Conservator of Forests, North Thána A. Division, on the 29th June last, before office hours, proceeded to Násik and received charge of the office of the Sub-Assistant Conservator of Forests, Násik, on the 3rd instant, before office hours, from the Divisional Forest Officer, Násik.

Mr. G. R. Mahajan, Sub-Assistant Conservator of Forests, 2nd grade, returned to duty on the 1st instant, before office hours, and was attached to the Conservator's office temporarily up to the 17th idem, when he proceeded to Sátára and received charge of the Sub-Assistant Conservator's office at Sátára and of the office of the Forest Demarcation of the Bhor State on the 22nd idem from the Divisional Forest officer, Sátára, before office hours.

Mr. N. B. Oka, Sub-Assistant Conservator of Forests, having returned from the Baroda State, received charge of the office of the Sub-Assistant Conservator of Forests at Násik on the 23rd June last, before noon, and proceeded, after handing over charge to the Division Forest officer, Násik, on the 25th idem, after office hours, to Thána, and received charge of the Sub-Assistant Conservator's office, North Thána A. Division, from *Mr. L. B. Oka* on the 29th June last, before office hours.

No. 5510*A.*—*The 3rd August, 1886.*—*Mr. G. P. Mulet*, Assistant Conservator of Forests, passed, on the 5th instant, an examination in Maráthi according to the Higher Standard under rule 7 of the rules published in Government Notification, No. 2878, dated 4th June, 1880, for the examination of Forest officers.

No. 5836.—*The 18th August, 1886.*—*Mr. Rustomji H. Mádan, L.C.E.*, to be 3rd grade Sub-Assistant Conservator of Forests vice *Mr. R. Ryan*, promoted, continuing to act as Assistant Conservator.

Mr. Tuljárám Nihálchand, Head Munshi to the Conservator of Forests, Sind Circle, to act as Sub-Assistant Conservator of Forests under the orders of the Conservator, Sind Circle.

No. 5864.—*The 17th August, 1886.*—*Mr. J. L. L. MacGregor*, Divisional Forest Officer, Belgaum, is allowed privilege leave of absence from the 8th to the 30th September, 1886, both days inclusive.

No. 5866.—*Mr. G. P. Millett*, Assistant Conservator of Forests, 3rd grade, is promoted to the 2nd grade, with effect from 8th April, 1886.

4.—CALCUTTA GAZETTE—

Nil.

5.—NORTH-WESTERN PROVINCES AND OUDH GAZETTE—

No. $\frac{2899}{\text{II-448-7-32}}$.—*The 15th July, 1886.—Captain E. S. Wood*, Conservator of Forests, 2nd grade, Oudh Circle, furlough to Europe for fifteen months, with effect from the 12th August, 1886, or subsequent date.

No. $\frac{2978}{\text{II-448-17-6}}$.—*The 17th July, 1886.—Mr. W. G. Allan*, Officiating Deputy Conservator of Forests, 2nd grade, Kheri Division, to the charge of the Pilibhit Division and Bhira sub-division, in addition to his own duties, during the absence on privilege leave of *Lieut.-Colonel J. E. Campbell*, or until further orders.

No. $\frac{3125}{\text{II-279-3-1}}$.—*The 28th July, 1886.*—With effect from the 3rd April, 1886, the date on which *Mr. S. E. Wilmot*, Deputy Conservator of Forests, 4th grade, took 2 months and 15 days' privilege leave—

Mr. F. B. Bryant, Assistant Conservator of Forests, 1st grade, to officiate as Deputy Conservator of Forests, 4th grade.

Mr. B. A. Rebsch, Assistant Conservator of Forests, 2nd grade, to officiate as Assistant Conservator of Forests, 1st grade.

No. $\frac{3126}{\text{II-279-3-2}}$.—With effect from the 18th June, 1886, the date on which *Mr. S. E. Wilmot* returned from privilege leave—

Mr. F. B. Bryant, officiating Deputy Conservator of Forests, 4th grade, to revert to his substantive appointment as Assistant Conservator of Forests, 1st grade.

Mr. B. A. Rebsch, officiating Assistant Conservator of Forests, 1st grade, to revert to his substantive appointment as Assistant Conservator of Forests, 2nd grade.

No. $\frac{3127}{\text{II-279-3-3}}$.—With effect from the 21st June, 1886, the date on which *Mr. C. Bagshawe*, Deputy Conservator of Forests, 2nd grade, was appointed to officiate as Conservator of Forests, 3rd grade—

Lieut.-Colonel J. E. Campbell, Deputy Conservator of Forests, 3rd grade, to officiate as Deputy Conservator of Forests, 2nd grade.

Mr. S. E. Wilmot, Deputy Conservator of Forests, 4th grade, to officiate as Deputy Conservator of Forests, 3rd grade.

Mr. F. B. Bryant, Assistant Conservator of Forests, 1st grade, to officiate as Deputy Conservator of Forests, 4th grade.

Mr. B. A. Rebsch, Assistant Conservator of Forests, 2nd grade, to officiate as Assistant Conservator of Forests, 1st grade.

6.—PUNJAB GAZETTE—

No. 337.—*The 16th August, 1886.*—*Mr. E. R. Murray*, Assistant Conservator, Montgomery Division, is granted three months' privilege leave with effect from the afternoon of the 31st July, 1886.

No. 339.—*Mr. C. F. Elliot*, Deputy Conservator of Forests, Mooltan Division, is appointed to the charge of the Montgomery Division, in addition to his own duties, with effect from the afternoon of the 31st July, 1886, and during the absence on privilege leave of *Mr. E. R. Murray*, Assistant Conservator.

No. 342.—*The 17th August, 1886.*—*Mr. W. Shakespear*, Deputy Conservator, returned to duty on the afternoon of the 31st July, 1886, from the three months' privilege leave granted by *Punjab Government Gazette* Notification No. 221, dated 21st May, and resumed charge of the Rawalpindi Division, relieving *Mr. J. L. Pigot*, Assistant Conservator.

No. 344.—The following reversions are ordered with effect from the 1st of August, 1886, in consequence of the return from privilege leave of *Mr. W. Shakespear*, Deputy Conservator, 3rd grade:—

Mr. F. O. Lemarchand, officiating Deputy Conservator, 3rd grade, to revert to Deputy Conservator, 4th grade.

Mr. L. G. Smith, officiating Deputy Conservator, 4th grade, to revert to Assistant Conservator, 1st grade.

Mr. J. Copeland, officiating Assistant Conservator, 1st grade, to revert to Assistant Conservator, 2nd grade.

7.—CENTRAL PROVINCES GAZETTE—

No. 3137.—*The 2nd August, 1886.*—*Mr. Mahomed Ghouse*, Sub-Assistant Conservator of Forests, availed himself on the forenoon of the 19th ultimo, of the three months' privilege leave granted to him by Notification No. 2832 of 29th June, 1886.

No. 3620.—*The 10th August, 1886.*—Consequent on the departure on three months' privilege leave of *Mr. L. A. W. Rind*, Deputy Conservator of Forests, 4th grade, in Berar, the following temporary promotions are made with effect from the 27th June, 1886.

Mr. W. King, Assistant Conservator of Forests, 1st grade, to officiate in the 4th grade of Deputy Conservators of Forests.

Mr. G. F. Taylor, Assistant Conservator of Forests, 2nd grade, in Berar, to officiate in the 1st grade of Assistant Conservators of Forests.

No. 3621.—Consequent on the departure on three months' privilege leave of *Mr. M. S. Fowler*, officiating Assistant Conservator, 1st grade, *Mr. H. B. Anthony*, Assistant Conservator, 2nd grade, is appointed to officiate in the 1st grade of Assistant Conservators of Forests, with effect from the 6th July, 1886.

8.—BURMA GAZETTE-

No. 21.—*The 22nd July, 1886.*—Under the provisions of sections 71 and 74 of the Civil Leave Code, *Mr. P. J. Carter*, Deputy Conservator of Forests, is granted three months' privilege leave, with effect from the 10th August, 1886, or the subsequent date on which he may avail himself of it.

No. 25.—*The 9th August, 1886.*—Under the provisions of sections 71 and 74 of the Civil Leave Code, privilege leave for three months is granted to *Mr. T. H. Aplin*, Deputy Conservator of Forests, with effect from the 17th August, 1886, or the subsequent date on which he may avail himself of it.

No. 26.—*Mr. J. C. Murray*, Assistant Conservator of Forests, is transferred from the charge of the Shwegun forest sub-division to the charge of the South Tenasserim division, Tenasserim forest circle.

No. 27.—Under the provisions of section 130 of Civil Leave Code, leave on private affairs for six months is granted to *Mr. C. W. Palmer*, Deputy Conservator of Forests, with effect from the date on which he may avail himself of it.

9.—ASSAM GAZETTE—

No. 230.—*The 29th July, 1886.*—*Mr. D. P. Copeland*, Assistant Conservator of Forests, 2nd grade, is promoted to officiate in the 1st grade, with effect from 2nd November, 1885. *Mr. Copeland* is confirmed in the 1st grade of Assistant Conservators, with effect from 11th November, 1885.

No. 282.—Privilege leave of absence for two months, under section 138, Chapter X. of the Civil Leave Code, is granted to *Babu Jogesvar Sur*, Sub-Assistant Conservator of Forests, Nowgong, with effect from the 1st August, 1886, or such subsequent date as he may avail himself of it.

No. 283.—*Mr J. T. Jellicoe*, Deputy Conservator of Forests, Darrang, is placed in charge of the Nowgong Forest Division in addition to his own duties, during the absence of leave of *Babu Jogesvar Sur.*

No. 284.—Privilege leave of absence for one month, under section 138, Chapter X. of the Civil Leave Code, is granted to *Babu Tari Kisor Gupta*, Sub-Assistant Conservator of Forests, Sylhet, with effect from the 15th July, 1886, or such subsequent date as he may avail himself of it.

10.—MYSORE GAZETTE—

Nil.

V. Extracts from Official Gazettes.

1.—Gazette of India—

No. 780F.—*The 3rd September, 1886.*—With reference to the Notification by the Government of the North-Western Provinces and Oudh, No. $\frac{1745}{\text{II-448-2-34}}$, dated the 6th May, 1886, the services of *Mr. A. F. Brown*, officiating Deputy Conservator of Forests, 4th grade, are replaced at the disposal of that Government, with effect from the 15th July last.

No. 805F.—*The 10th September, 1886.*—In supersession of the notification of this Department No. 702F., dated the 13th ultimo, it is hereby notified that the following temporary promotions are made during the absence on seventy-three days' privilege leave of *Mr. A. L. Home*, Conservator of Forests of the 3rd (officiating 2nd) grade, in Bengal :—

Mr. E. G. Chester, Deputy Conservator of Forests of the 3rd grade, in Bengal, to officiate in the 3rd grade of Conservators, and to have charge of the Forest Department in Bengal, from the 9th June to the 20th August, 1886 (inclusive).

Mr. H. C. Hill, officiating Conservator of Forests of the 3rd grade, in the Punjab, to officiate in the 2nd grade of Conservators, from the 21st June, to the 12th August, 1886 (inclusive), *vide* Notifications No. 513F., dated the 19th June, and No. 604F., dated the 23rd July, 1886.

Mr. W. R. Fisher, B.A., officiating Conservator of Forests of the 3rd grade, in charge of the School Circle in the North-Western Provinces and Oudh, to officiate in the 2nd grade of Conservators from the 13th to the 20th August, 1886 (inclusive), *vide* Notification No. 513F., dated the 19th June, 1886.

No. 848F.—*The 24th September, 1886.*—In supersession of the Notification of the Home Department, No. 252F., dated the 9th April last, it is hereby notified that *Mr. H. H. Davis*, Deputy Conservator of Forests of the 2nd grade in Bengal and officiating in the 1st grade of Deputy Conservators, held the appointment of Deputy Conservator of the 1st grade substantively *pro tempore* from the 11th November, 1885, to the 20th June, 1886 (inclusive), reverting to his officiating appointment in that grade on the 21st June, 1886; and that *Mr. H. C. Hill*, Deputy Conservator of the 2nd grade in Burma and officiating Conservator of Forests in the Punjab, is appointed permanently to the 1st grade of Deputy Conservators, with effect from the 21st June, 1886.

2.—MADRAS GAZETTE—

The 9th August, 1886.—*Mr. H. W. Ward*, Forest Ranger 2nd (officiating 1st) grade, to act as Sub-Assistant Conservator, 2nd grade, while in charge of the office of District Forest officer, Kurnool.

The 31st August, 1886.—The following temporary promotions in the Forest Department, Northern Circle, will take effect from the 17th August, 1886, on which date *Mr. H. H. Ward*, Forest Ranger, 2nd, acting 1st, grade, acted as Sub-Assistant Conservator:—

To act in 1st grade of Forest Rangers:—

Mr. T. G. A. Gaudoin, Forest Ranger, 3rd, acting 2nd, grade, in Kistna District.

To act in 2nd grade of Forest Rangers:—

T. M. Nallasawmy Naidu, Forest Ranger, 4th, acting 3rd, grade, in Nilgiris.

To act in 3rd grade of Forest Rangers:—

D. Srinivasa Rao, Forest Ranger, 4th grade, in Nellore.

To be Forest Ranger, 5th grade, on probation, in Kurnool:—

Mr. Payne, Forester, 2nd grade, from 1st September, 1886.

The 26th August, 1886.—*C. M. Maduranayagam Pillai*, Forest Ranger, 4th grade, (on probation,) Coimbatore (South), is granted one month's privilege leave under section 138 of the Civil Leave Code from date of relief.

The 31st August, 1886.—In the notification of appointment under "Forest," published at page 1298, Part II. of the *Fort St. George Gazette*, dated 20th August, 1886—

For 'Mr. H. W. Ward,' read 'Mr. H. H. Ward.'

The 8th September, 1886.—*T. Venkatasubba Aiyar*, Forest Ranger, 3rd grade, North Arcot, privilege leave for three months under section 138 of the Civil Leave Code, from 17th August or date of relief.

Mr. R. S. Bower, B.A., to act as Ranger, 3rd grade, during the suspension of Ranger *Quadir Hussain Sahib*, or until further orders. To do duty in North Arcot.

Mr. C. J. Couteraz, Forest Ranger, 3rd grade, Trichinopoly, to act in the 2nd grade until further orders, with effect from 1st September, 1886.

Ramalinga Mudaliyar, Forester, 1st grade, North Arcot, to act as Forest Ranger, 3rd grade, during the absence of *T. Venkatasubba Aiyar*, on leave, or until further orders.

A. Durgayya Nayudu, Ranger, acting 3rd grade, North Arcot, and *M. Shums-ud-din Sahib*, Ranger, acting 4th grade, Salem, are confirmed in their respective grades with effect from 1st September, 1886.

N. Arumuga Mudaliyar, Ranger, acting 2nd grade, Coimbatore (South), and *Mr. W. P. Rego*, Ranger, acting 3rd grade, South Canara, to revert to 3rd and 4th grades respectively, with effect from 1st September, 1886.

The 20th September, 1886.—*S. Coomarasawmy Mudelly*, a passed student of the Agricultural College, Madras, is appoint-

ed to officiate as Forest Ranger, 5th grade, *vice Mr. Ward*, Acting Sub-Assistant Conservator. He is posted to the Cuddapah District.

V. Kalyanarama Iyer, a passed student of the Agricultural College, Madras, is appointed to be Forest Ranger, 5th grade, on probation, subject to his passing the Departmental Test and the Surveying Tests within one year. He is posted to the Anantapur District.

The 22nd September, 1886.—*V. S. Gurunada Pillai*, Sub-Assistant Conservator, 2nd grade, (on probation), Coimbatore (South), having passed the Departmental Test in Forest Code and Act, is confirmed in his appointment as Sub-Assistant Conservator, 2nd grade, from 21st July, 1886.

C. N. Lakshmana Rao, Ranger, 3rd grade, Salem District, to act as Sub-Assistant Conservator of Forests, 2nd grade, Wynaad and Palghat, during the absence of *Mr. Howell* on leave, or until further orders.

C. Dhansing, Forester, 2nd grade, to act as Ranger, 5th grade, in Trichinopoly till further orders.

T. Marya Pillai, Ranger, 4th grade, from Trichinopoly to Salem.

3.—BOMBAY GAZETTE—

The 8th September, 1886.—*Messrs. H. W. Keys* and *R. H. Madan*, 1st grade Assistant and acting Assistant Conservators of Forests, respectively delivered over and received charge of the office of the Divisional Forest officer, Panch Máhála, on the 3rd September, 1886, before office hours.

Messrs. R. H. Madan, acting Assistant Conservator, 3rd grade, and *S. Hornidge*, acting Assistant Conservator of Forests, 1st grade, and Divisional Forest officer, South Thána, respectively delivered over and received charge of the office of the Sub-Assistant Conservator of Forests, A sub-division of the South Thána Division, on the forenoon of the 1st instant.

The 14th September, 1886.—*Messrs. J. L. R. MacGregor* and *H. E. Andrews*, respectively delivered over and received charge of the office of the Divisional Forest Officer, Belgaum, on the 8th instant, after office hours.

4.—CALCUTTA GAZETTE—

The 2nd September, 1886.—Three months' examination leave, under section 57 of the Forest Department Code, is granted to *Mr. E. E. Wylly*, Sub-Assistant Conservator of Forests, in charge of the Khoorda sub-division of the Orissa Forest Division, with effect from the forenoon of the 16th August, 1886, on being relieved of his duties by *Mr. H. H. Davis*, Deputy Conservator of Forests, Orissa Forest Division, who will remain in temporary charge of the sub-division in addition to his other duties during *Mr. Wylly's* absence on leave, or until further orders.

The 14th September, 1886.—Consequent on three months' privilege leave of absence, from the 16th April, 1886, having been granted to *Mr. F. B. Manson*, Deputy Conservator of Forests of the 3rd grade, and on the temporary promotion of *Mr. E. G. Chester*, Deputy Conservator of Forests of the 3rd grade, to officiate as Conservator of Forests in Bengal from the 9th June, 1836, the following temporary promotions are made:—

Mr. W. M. Green, Deputy Conservator, 4th grade, to officiate in the 3rd grade of Deputy Conservators from the 16th April, to the 20th August, 1886,

Mr. W. Johnston, Deputy Conservator, 4th grade, to officiate in the 3rd grade of Deputy Conservators from the 9th June to the 16th July, 1886.

The 16th September, 1886.—The following transfers and postings are ordered:—

Mr. W. Johnston, Deputy Conservator of Forests, is transferred from the Teesta sub-division of the Darjeeling Division to the charge of the Julpigoree Division.

Mr. A. R. Grant, Deputy Conservator of Forests, is transferred at his own request from the Julpigoree Forest Division to the charge of the Teesta Forest sub-division.

Mr. Johnston will make over temporary charge of the Teesta sub-division to *Mr. W. M. Green*, Deputy Conservator of Forests, Darjeeling sub-division, who will retain charge of both sub-divisions, until relieved by *Mr. Grant*.

The 16th September, 1886.—Examination leave for two months, under section 57, Part III, Chapter I. of the Forest Department Code, is granted to *Mr. H. D. D. French*, Assistant Conservator of Forests, attached to the Working Plans Division with effect from the 3rd instant.

5.—NORTH-WESTERN PROVINCES AND OUDH GAZETTE—

No. $\frac{3834}{\text{II-448-17-12}}$.—*The 3rd September, 1886.*—*Mr. B. A. Rebsch*, Assistant Conservator of Forests, Gonda Division, to the charge of the Bahraich Forests Division, in addition to his own duties, with effect from the afternoon of the 31st July, 1886.

No. $\frac{3743}{\text{II-497-17}}$.—*The 6th September, 1886.*—With effect from the 27th July, 1886—

Mr. W. G. Allan, Deputy Conservator of Forests, 3rd grade, officiating in the 2nd grade, to be confirmed in the latter grade;

Mr. J. M. Braidwood, Deputy Conservator of Forests, 4th grade, officiating in the 3rd grade, to be confirmed in the latter grade;

Mr. N. Hearle, Assistant Conservator of Forests, 1st grade, officiating Deputy Conservator of Forests, 4th grade, to be Deputy Conservator of Forests, 4th grade;

Mr. M. H. Clifford, Assistant Conservator of Forests, 2nd

grade, officiating in the 1st grade; to be confirmed in the latter grade.

6.—PUNJAB GAZETTE—

No. 315.—*The 21st August, 1886.*—*Mr. J. Copeland*, Assistant Conservator of Forests, 2nd grade, is, on return from the privilege leave of absence granted to him by Punjab Government Notification No. 257, dated the 11th of June, 1886, transferred for service in Burma as a substantive Assistant Conservator of the 1st grade.

No. 371.—*The 4th September, 1886.*—*Mr. W. E. D'Arcy*, Deputy Conservator of Forests, in charge of the Working Plans Division, is granted furlough for two years under Section 50 of the Civil Leave Code, with the usual subsidiary leave. *Mr. D'Arcy* availed himself of the subsidiary leave on the forenoon of the 25th August, 1886.

No. 371½.—*Mr. J. L. Pigot*, Assistant Conservator of Forests, Rawalpindi Division, is transferred to the charge of the Working Plans Division, which he received from *Mr. W. E. D'Arcy* on the afternoon of the 24th August, 1886.

No. 377.—*The 8th September, 1886.*—*Mr. J. Copeland*, Assistant Conservator of Forests, reported his return to duty on the afternoon of the 28th August from the privilege leave for three months granted by *Punjab Government Gazette* Notification, No. 257, dated 11th June, 1886, and proceeded to Burma, to which Province he has been transferred by *Punjab Government Gazette* Notification, No. 315, dated 21st August, 1886.

7.—CENTRAL PROVINCES GAZETTE—

Nil.

8.—BURMA GAZETTE—

No. 28.—*The 16th August, 1886.*—*Mr. C. Ingram*, Probationary Sub-Assistant Conservator of Forests, is confirmed in the grade of Sub-Assistant Conservator of Forests, with effect from the 1st July, 1886.

No. 29.—*The 18th August, 1886.*—Under the provisions of section 138 of the Civil Leave Code, privilege leave for fifteen days was granted to *Mr. T. A. Hauxwell*, Assistant Conservator of Forests, in extension of the leave granted to him in this Department Notification No. 17 (Forests), dated the 7th June, 1886.

9.—ASSAM GAZETTE—

No. 357.—*The 20th September, 1886.*—*Babu Tara Kisor Gupta*, Sub-Assistant Conservator of Forests, reported his return from privilege leave and resumed charge of the Sylhet Forest Division on the forenoon of the 13th instant.

No. 358.—*The 22nd September, 1886.*—*Mr. F. S. Barker*, Assistant Conservator of Forests, 1st grade, Lakhimpur, is trans-

ferred to Sibságar and placed in charge of the Sibságar Forest Division.

No. 359.—*Mr. C. G. D. Fordyce*, Assistant Conservator of Forests, 1st grade, Sibságar, is transferred to Dibrugarh, and placed in charge of the Lakhimpur Forest Division.

10.—MYSORE GAZETTE—

Nil.

JV. EXTRACTS FROM OFFICIAL GAZETTES.

1.—GAZETTE OF INDIA—

Nil.

2.—MADRAS GAZETTE—

The 30th September, 1886.—*Mr. M. S. Noronha*, Forest Ranger, 5th grade, (on probation,) is transferred from Trichinopoly to the South Canara district.

The 14th October, 1886.—*T. Venkatasubba Aiyar*, Forest Ranger, 3rd grade, North Arcot, on 29th September, 1886.

Mr. E. F. R. Richter, to be Forest Ranger, 5th grade, on probation for one year from date of joining.

Ramalinga Mudaliar, Forester, 1st grade, to act as Forest Ranger, 5th grade, (sub. *pro tem*), North Arcot, from 30th September, 1886, until further orders.

The 23rd October, 1886.—*M. R. Ry. V. A. Parthasarathy Moodelly*, Manager, office of Conservator of Forests, Southern Circle, has been recalled to duty on the 15th instant from the privilege leave published in page 1608, Part II. of the *Fort St. George Gazette*, dated 8th October, 1886.

3.—BOMBAY GAZETTE—

The 12th October, 1886.—*Messrs. C. E. Frost*, C.S., and *R. H. Madan*, Forest Settlement Officer, Násik, and Acting Assistant Conservator of Forests, respectively delivered over and received charge of the office of the Divisional Forest Officer, Násik, on the 6th October, 1886, forenoon.

Messrs. W. G. Betham, and *C. E. Frost*, C.S., Deputy Conservator of Forests, 3rd grade, and Forest Settlement Officer, Násik, respectively delivered over and received charge of the office of the Divisional Forest office, Nasik, on the 4th October 1886, after noon.

Messrs. R. H. Madan and *H. W. Keys*, Assistant Conservator of Forests, and Acting Assistant Conservator of Forests, respectively delivered over and received charge of the office of the Divisional Forest Officer, Panch Mahals, on the 4th October, 1886, before office hours.

No. 7622.—*The 27th October, 1886.*—*Mr. W. H. A. Wallinger*, Deputy Conservator of Forests, 1st grade, has been granted an extension for six months of the furlough on medical certificate for one year allowed him by Government Notification No. 8821,

dated 30th October, 1885, published at page 1273 of the *Bombay Government Gazette*, Part I., of 5th November, 1885.

No. 7626.—*The 10th October, 1886.*—*Mr. G. M. Ryan*, Sub-Assistant Conservator of Forests, 3rd grade, has been allowed by Her Majesty's Secretary of State for India an extension of leave for three months on sick certificate.

4.—CALCUTTA GAZETTE—

The 25th September, 1886.—*Mr. A. L. Home*, Conservator of Forests, 3rd grade, Bengal, was granted privilege leave of absence from the 9th June, 1886, to the 20th August following, both days inclusive, under sections 71 to 74, Chapter V. of the Civil Leave Code.

The 16th October, 1886.—The following transfers and postings are ordered:—

Mr. J. C. Mendes, Sub-Assistant Conservator of Forests, is transferred from the Kurseong Sub-division of the Darjeeling Division to the charge of the Palamow Sub-division of the Chota Nagpore Division.

Mr. C. A. G. Lillingston, Deputy Conservator of Forests, is transferred from the Palamow Sub-division of the Chota Nagpore Division to the charge of the Kurseong Sub-division of the Darjeeling Division.

Mr. W. M. Green, Deputy Conservator of Forests, Darjeeling Sub-division, will assume charge of the Kurseong Sub-division from *Mr. J. C. Mendes*, and will hold charge of that Sub-division in addition to his other duties, until relieved by *Mr. Lillingston*.

Mr. E. E. Wylly, Sub Assistant Conservator of Forests, is transferred from the Khorda Sub-division of the Orissa Division to the Sunderbans Division, to which Division he will be attached with head-quarters at Khoolna. *Mr. H. H. Davis*, Deputy Conservator of Forests, Orissa Division, will hold charge of the Khorda Sub-division of that Division in addition to his other duties until further orders.

5.—NORTH-WESTERN PROVINCES AND OUDH GAZETTE—

No. $\frac{4420}{\text{II-445-6-32}}$.—*The 11th October, 1886.*—*Mr. N. Hearle*, Officiating Deputy Conservator of Forests, 3rd grade, attached to the Central Circle, on return from privilege leave, to the School Circle on special duty, to complete the working plans of the Tehri Forests and valuation of Deoban forests.

No. $\frac{4475}{\text{II-279-4-}}$.—*The 13th October, 1886.*—With effect from the 26th July, 1886, the date on which *Mr. A. Smythies* returned from deputation—

Mr. A. Smythies, Deputy Conservator of Forests, 4th grade, to officiate as Deputy Conservator of Forests, 3rd grade;

Mr. S. E. Wilmot, Officiating Deputy Conservator of Forests, 3rd grade, to revert to his substantive appointment as Deputy Conservator of Forests, 4th grade;

Mr. F. B. Bryant, Officiating Deputy Conservator of Forests, 4th grade, to revert to his substantive appointment as Assistant Conservator of Forests, 1st grade;

Mr. B. A. Rebsch, Officiating Assistant Conservator of Forests, 1st grade, to revert to his substantive appointment as Assistant Conservator of Forests, 2nd grade.

No. $\frac{4476}{\text{II-279-4-2}}$.—With effect from the 27th July, 1886, the date on which *Mr. W. G. Allan* was confirmed as Deputy Conservator of Forests, 2nd grade—

Mr. J. M. Braidwood, Deputy Conservator of Forests, 3rd grade, to officiate as Deputy Conservator of Forests, 2nd grade.

No. $\frac{4477}{\text{II-279-4-3}}$.—With effect from the 27th July, 1886, the date on which *Mr. J. M Braidwood* was confirmed as Deputy Conservator of Forests, 3rd grade—

Mr. S. E. Wilmot, Deputy Conservator of Forests, 4th grade, to officiate as Deputy Conservator of Forests, 3rd grade.

No. $\frac{4478}{\text{II-279-4-4}}$.—With effect from the 27th July, 1886, the date on which *Mr. N. Hearle* was confirmed as Deputy Conservator of Forests, 4th grade—

Mr. F. B. Bryant, Assistant Conservator of Forests, 1st grade, to officiate as Deputy Conservator of Forests, 4th grade.

No. $\frac{4479}{\text{II-279-4-5}}$.—With effect from the 27th July, 1886, the date on which *Mr. M. H. Clifford* was confirmed as Assistant Conservator of Forests, 1st grade—

Mr. B. A. Rebsch, Assistant Conservator of Forests, 2nd grade, to officiate as Assistant Conservator of Forests, 1st grade.

No. $\frac{4480}{\text{II-279-4-6}}$.—With effect from the afternoon of the 31st July, 1886, the date on which the services of *Mr. E. P. Dansey*, Officiating Deputy Conservator of Forests, 3rd grade, were placed at the disposal of the Government of India, Home Department—

Mr. N. Hearle, Deputy Conservator of Forests, 4th grade, to officiate as Deputy Conservator of Forests, 3rd grade;

Mr. M. H. Clifford, Assistant Conservator of Forests, 1st grade, to officiate as Deputy Conservator of Forests, 4th grade.

No. $\frac{4481}{\text{II-279-4-7}}$.—With effect from the 5th August, 1886, *vice Mr. W. R. J. Brereton*, Deputy Conservator of Forests, 1st grade, absent on privilege leave—

Mr. A. Smythies, Officiating Deputy Conservator of Forests, 3rd grade, to officiate as Deputy Conservator of Forests, 2nd grade;

Mr. E. F. Litchfield, Officiating Deputy Conservator of Forests, 4th grade, to officiate as Deputy Conservator of Forests, 3rd grade;

Mr. A. G. Hobart-Hampden, Officiating Assistant Conser-

vator of Forests, 1st grade, to officiate as Deputy Conservator of Forests, 4th grade.

No. $\frac{4482}{\text{II-279-4-8}}$.—With effect from the 7th August, 1886, *vice Mr. N. Hearle*, Officiating Deputy Conservator of Forests, 3rd grade, absent on privilege leave.

Mr. A. P. Broun, Officiating Deputy Conservator of Forests, 4th grade, to officiate as Deputy Conservator of Forests, 3rd grade;

Mr. A. Campbell, Officiating Assistant Conservator of Forests, 1st grade, to officiate as Deputy Conservator of Forests, 4th grade

No. $\frac{4483}{\text{II-279-4-9}}$.—With effect from the 4th September, 1886, *vice Lieutenant-Colonel J. E. Campbell*, Officiating Deputy Conservator of Forests, 2nd grade, absent on privilege leave—

Mr. S. E. Wilmot, Officiating Deputy Conservator of Forests, 3rd grade, to officiate as Doputy Conservator of Forests, 2nd grade;

Mr. F. B. Bryant, Officiating Deputy Conservator of Forests, 4th grade, to officiate as Deputy Conservator of Forests, 3rd grade;

Mr. B. A. Rebsch, Officiating Assistant Conservator of Forests, 1st grade, to officiate as Deputy Conservator of Forests, 4th grade.

No. $\frac{4484}{\text{II-279-4-10}}$.—With effect from the 24th September, 1886, the date on which *Mr. W. R. J. Brereton*, Deputy Conservator of Forests, 1st grade, returned from privilege leave—

Mr. S. E. Wilmot, Officiating Deputy Conservator of Forests, 2nd grade, to officiate as Deputy Conservator of Forests, 3rd grade;

Mr. F. B. Bryant, Officiating Deputy Conservator of Forests, 3rd grade, to officiate as Deputy Conservator of Forests, 4th grade;

Mr. B. A. Rebsch, Officiating Deputy Conservator of Forests, 4th grade, to officiate as Assistant Conservator of Forests, 1st grade.

No. $\frac{4493}{\text{II-448-17-18}}$.—*The 13th October, 1886.*—In this Department Notification No. $\frac{3834}{\text{II-448-17-12}}$, dated the 8th September, 1886, after the words "with effect from the afternoon of the 31st July, 1886," add "the date on which *Mr. E. P. Dansey*, Deputy Conservator of Forests, relinquished charge of the latter Division.

6.—PUNJAB GAZETTE—

No. 7135.—*The 22nd October, 1886.*—With the sanction of the Punjab Government the Financial Commissioner issues the following instructions for the regulation of the proceedings taken by Forest officers under Section 67 of the Indian Forest Act (No. VII. of 1878).

FORESTS.

Instructions for regulation of proceedings taken by Forest Officers under Section 67 of the Forest Act, No. VII of 1878.

2.—By the notifications quoted in the margin, all Deputy Conservators, Assistant Conservators and Sub-Assistant Conservators of Forests, when in charge of Forest Divisions, are empowered to make certain compositions in accordance with the terms of Section 67 of the Indian Forest Act, with persons who are reasonably suspected of having committed a forest offence.

Punjab Government, No. 533, dated 8th December, 1879. Copy annexed, together with the last order fixing the limits of these Divisions.

3.—It is obvious that as a general rule powers such as those conferred by Section 67 should be exercised in personal communication with the person affected by them, and it should only rarely be necessary to proceed on written reports of subordinates, and in the absence of the person offering the composition. At the same time when the amount of damage done is insignificant, if it is necessary to take compensation at all, it would be manifestly inequitable to drag a herdsman a long distance in order to make a petty payment of a rupee or two to the Forest officer. In all such cases in which Forest officers accept compositions under Section 67, otherwise than in personal communication with the person offering the composition, the Financial Commissioner directs that this circumstance, and the reason for it, shall be noted in the Register prescribed by paragraph 7 of this Circular.

4.—The Financial Commissioner also desires Deputy Commissioners and Forest officers to bear in mind that the mere fact that cattle have trespassed in reserve forests does not by itself constitute a reasonable suspicion of the commission of a forest offence. In addition to the fact of the trespass there must be reasonable grounds to suspect that it was occasioned or permitted by the person offering the composition. When accepting a composition the Forest officer should record (in Column 4 of Register appended) what these grounds are in the particular case.

5.—It is also necessary to remember that compositions to be paid is by way of compensation for any damage which may have been committed, and not by way of a fine. The damage should, therefore, be fairly estimated by the Forest officer on facts brought to his notice, and should not be assumed as probable. And if, with reference to the circumstances of any case, the Forest officer considers that a composition restricted in this manner will not be suitable, he should bring the case before the Magistrate for prosecution.

6.—At the same time as a Forest officer compounds an offence, he may release on payment of its value any property seized under the authority of Section 52. The value demanded for such property should be fairly estimated. If the Forest officer is unwilling to release the property seized, it will usually be best to refrain from compounding the offence, for the refusal to release the property seized necessitates a reference of the case to the Magistrate.

7.—The Financial Commissioner further directs that records of proceedings preliminary to a demand for compensation be made

as brief and informal as possible. Every officer empowered under Section 67 of the Act should keep a Register in the form appended, in which he will enter in his own hand, as they occur, the cases dealt with under that Section—only those cases need be entered in which a composition is actually paid.

Form of Register referred to in paragraph 7.

1	2	3	4	5	6	7	8	9
Serial No.	Name and description of offender.	Forest in which offence was committed.	Particulars of offence and damage caused by offence, and date thereof.	Detail of property seized.	*Composition paid.* On account of damage caused by offence.	*Composition paid.* On account of value of property seized and released.	Date of payment.	Signature of compounding officer.

7.—CENTRAL PROVINCES GAZETTE—

No. 4730.—*The 14th October, 1886.—Mr. Mahadeo Rao Palnaitkar*, Sub-Assistant Conservator of Forests, availed himself, on the afternoon of the 1st current, of the one month's privilege leave granted him by Notification No. 4057 of 4th September, 1886.

8.—BURMA GAZETTE—

Nil.

9.—ASSAM GAZETTE—

Nil.

10.—MYSORE GAZETTE—

Nil.

JV. Extracts from Official Gazettes.

1.—Gazette of India.

No. 1060.—*The 26th November, 1886.*—*Mr. E. P. Dansey*, Assistant Inspector General of Forests and Superintendent of Working-Plans, is granted privilege leave of absence for three weeks, with effect from the 3rd January, 1887.

2.—Madras Gazette—

No. 394.—*The 6th November, 1886.*—The Right Honorable the Secretary of State for India has permitted *Mr. A. W. Peet*, Deputy Conservator of Forests, to return to duty within the period of his leave.

The 6th November, 1886.—*Mr. C. P. Howell*, Sub-Assistant Conservator of Forests, Wynaad and Palghat, is granted two months and fourteen days' privilege leave, under section 138 of the Civil Leave Code, with effect from the 22nd September, 1886.

This supersedes the notification published on page 1533, Part II. of the *Fort St. George Gazette* dated 17th September, 1886.

In page 1560 of Part II. of the *Fort St. George Gazette*, dated 24th September, 1886, containing the appointment of *C. N. Lakshmana Rao*, as Acting Sub-Assistant Conservator of Forests, 2nd grade, the words "during the absence of *Mr. Howell* on leave or" should be omitted.

No. 404.—*The 17th November, 1886.*—*Mr. E. D. M. Hooper*, Deputy Conservator of Forests, 3rd grade, having reported his return from extraordinary leave on the forenoon of the 15th November, 1886, the unexpired portion of his leave notified at page 872, Part I. of the *Fort St. George Gazette*, dated 1st October, 1886, is cancelled at his own request.

No. 410.—*The 18th November, 1886.*—*Mr. E. D. M. Hooper*, Deputy Conservator of Forests, 3rd grade, District Forest Officer, Bellary, to be District Forest Officer, Kurnool.

The 19th November, 1886.—*Mr. S. Hornidge*, A.M.I.C.E., Assistant Conservator of Forests, delivered over and *Mr. R. H. Madan*, Acting Assistant Conservator of Forests, received charge of the A. Sub-divisional Forest office of South Thána in the forenoon of the 6th November, 1886.

No. 414.—*The 23rd November, 1886.*—*Mr. E. D. M. Hooper*, Deputy Conservator of Forests, 3rd grade, will be considered to have been on special duty from the 15th November, 1886, to the date of joining his appointment at Kurnool.

No. 421.—*The 30th November, 1886.*—*Mr. A. W. Peet*, Deputy Conservator of Forests, 2nd grade, to act as District Forest Officer, Madura, during the absence of *Mr. Gass* on leave, or until further orders.

No. 422.—*Mr. W. C. Hayne*, Deputy Conservator of Forests, 3rd grade, to be District Forest Officer, Coimbatore (North).

No. 423.—*Mr. A. W. C. Stanbrough*, Deputy Conservator of Forests, 4th grade, to be District Forest Officer, Tanjore, from date of assuming charge, in addition, and without prejudice, to his duties as District Forest Officer, Trichinopoly.

3.—BOMBAY GAZETTE—

The 9th November, 1886.—*Messrs. R. H. Madan*, Acting Assistant Conservator of Forests, 3rd grade, and *V. G. Betham*, Deputy Conservator of Forests, 3rd grade, respectively delivered over and received charge of the Divisional Forest office, Násik, on the 5th November, 1886, forenoon.

No. 8444.—*The 30th November, 1886.*—*Mr. W. A. Talbot*, Deputy Conservator of Forests, 4th grade, has been allowed by Her Majesty's Secretary of State for India an extension of furlough for six months.

4.—CALCUTTA GAZETTE—

Nil.

5.—NORTH-WESTERN PROVINCES AND OUDH GAZETTE—

No. $\frac{5131}{\text{II-279-4-15}}$.—*The 24th November, 1886.*—In the Notification from this Department, No. $\frac{4482}{\text{II-279-4}}$, dated the 13th October, 1886, promoting certain Forest Officers *vice Mr. N. Hearle* on privilege leave, *for* "7th August," *read* "5th August."

No. $\frac{5214}{\text{II-279-4-22}}$.—*The 29th November, 1886.*—In the Notification from this Department, No. $\frac{4431}{\text{II-279-4}}$, dated the 13th October, 1886, promoting certain Forest Officers *vice Mr. R. J. Brereton* on privilege leave, *for* "5th August," *read* "4th August."

No. $\frac{5218}{\text{II-279-4-26}}$.—In the Notification from this Department, No. $\frac{4483}{\text{II-279-4}}$, dated the 13th October, 1886, promoting certain Forests Officers *vice Lieutenant-Colonel J. E. Campbell* on privilege leave, *for* "4th September," *read* "3rd September."

6.—PUNJAB GAZETTE—

No. 468.—*The 16th November, 1886.*—In continuation of *Punjab Government Gazette* Notification No. 437, dated 27th October, 1886, it is hereby notified that *Mr. A. L. McIntire*, Assistant Conservator, reported his return to duty from Examination

leave on the forenoon of the 28th idem on which date he assumed charge of the Working Plans Division.

7.—CENTRAL PROVINCES GAZETTE—

No. 5046.—*The 4th November, 1886.*—*Mr. Mahomed Ghause*, Sub-Assistant Conservator of Forests, returned from the privilege leave granted to him by Notification No. 2832, dated 29th June, 1886, and resumed charge of his duties in the Balaghat district on the afternoon of the 18th ultimo.

No. 5131.—*The 12th November, 1886.*—Three weeks' sick leave is granted to *Mr. J. McKee*, Deputy Conservator of Forests, from the afternoon of the 2nd September, 1886.

Notification No. 3917, dated 27th August, 1886, is cancelled.

No. 5132.—*Mr. J. McKee*, Deputy Conservator of Forests, is transferred from the Direction to the Hoshangabad Division.

On being relieved by *Mr. McKee*, Deputy Conservator of Forests, *Colonel H. C. T. Jarrett*, v.c., Deputy Conservator of Forests, is transferred to the Saugor Division.

No. 5133.—*Mr. J. McKee*, Deputy Conservator of Forests, received charge of the Hoshangabad Division from *Colonel H. C. T. Jarrett*, v.c., Deputy Conservator of Forests, on the forenoon of the 23rd September, 1886.

Colonel H. C. T. Jarrett, v.c., Deputy Conservator of Forests, received charge of the Saugor Division from *Mr. W. P. Thomas*, Deputy Conservator of Forests, on the forenoon of the 11th October, 1886.

Mr. W. P. Thomas, Deputy Conservator of Forests, is transferred to the Narsinghpur District.

No. 5134.—*Mr. M. S. Fowler*, Assistant Conservator of Forests, returned to duty on the forenoon of the 6th October, 1886, from the privilege leave granted to him by Notification No. 2738, dated 23rd June, 1886.

Mr. M. S. Fowler, Assistant Conservator of Forests, is posted to the Hoshangabad Division, which he joined on the afternoon of the 12th October, 1886.

No. 5135.—One year's furlough is granted to *Mr. J. McKee*, Deputy Conservator of Forests, under Section 132, Chapter X., of the Civil Leave Code, from the 1st instant, or the subsequent date on which he may avail himself of it.

No. 5318.—*The 19th November, 1886.*—In Notification No. 5125, dated 11th instant, regarding the date on which *Mr. Muttanah*, Officiating Assistant Conservator of Forests, 3rd grade, joined the Mandla Division—

for, "the 14th *instant*, before noon;"
read, "the 14th *ultimo*, before noon."

No. 5348.—*The 23rd November, 1886.*—*Mr. Mahadeo Rao Pulnaitkar*, Sub-Assistant Conservator of Forests, returned from the privilege leave granted to him by Notification No. 4057, dated 4th September, 1886, and resumed charge of his duties in the Mandla Division on the forenoon of the 2nd instant.

No. 5116.—*The 26th November, 1886.*—*Mr. J. McKee*, Deputy Conservator of Forests, availed himself, on the afternoon of the

7th instant, of the one year's furlough granted him by Notification No. 5135, dated the 12th idem, making over charge of the Hoshangabad Forest Division to *Mr. M. S. Fowler*, Assistant Conservator of Forests.

8.—Burma Gazette—

No. 44.—*The 3rd November, 1886.*—*Mr. P. J. Carter*, Deputy Conservator of Forests, is transferred to the Andamans.

No. 45.—*Mr. M. H. Ferrars*, Deputy Conservator of Forests, on arrival in Burma, is posted to the charge of the Ataran Division, Tenasserim Circle.

No. 46.—*Mr. T. H. Aplin*, Deputy Conservator of Forests, on return from privilege leave, is posted to the charge of the Tharrawaddy Division.

No. 47.—*Captain C. T. Bingham*, Deputy Conservator of Forests, is appointed to the charge of the Rangoon Division.

No. 48.—*Mr. H. R. Ward*, Deputy Conservator of Forests, is appointed to the charge of the Western Division.

No. 49.—*Mr. J. Copeland*, officiating Deputy Conservator of Forests, is appointed to the charge of the Shwegyin Division.

9.—Assam Gazette—

No. 402.—*The 18th November, 1886.*—*Mr. F. S. Barker*, Assistant Conservator of Forests, on return from privilege leave, assumed charge of the Sibságar Forest Division from *Mr. C. G. D. Fordyce* on the afternoon of the 1st November, 1886.

No. 403.—*The 21st November, 1886.*—Consequent on the temporary promotion of *Mr. W. M. Green*, Deputy Conservator, 4th grade, in Bengal, to 3rd grade of Deputy Conservator from the 16th April to the 20th August, 1886, the Chief Commissioner is pleased to sanction the following temporary promotions in the Forest Department, Assam:—

Mr. C. G. D. Fordyce, Assistant Conservator of the 1st grade, to officiate as Deputy Conservator of the 4th grade from the 16th April to the 20th August, 1886.

Mr. T. J. Campbell, Assistant Conservator of the 2nd grade, to officiate in the 1st grade of Assistant Conservators from the 16th April to the 20th August, 1886.

10.—Mysore Gazette—

Nil.